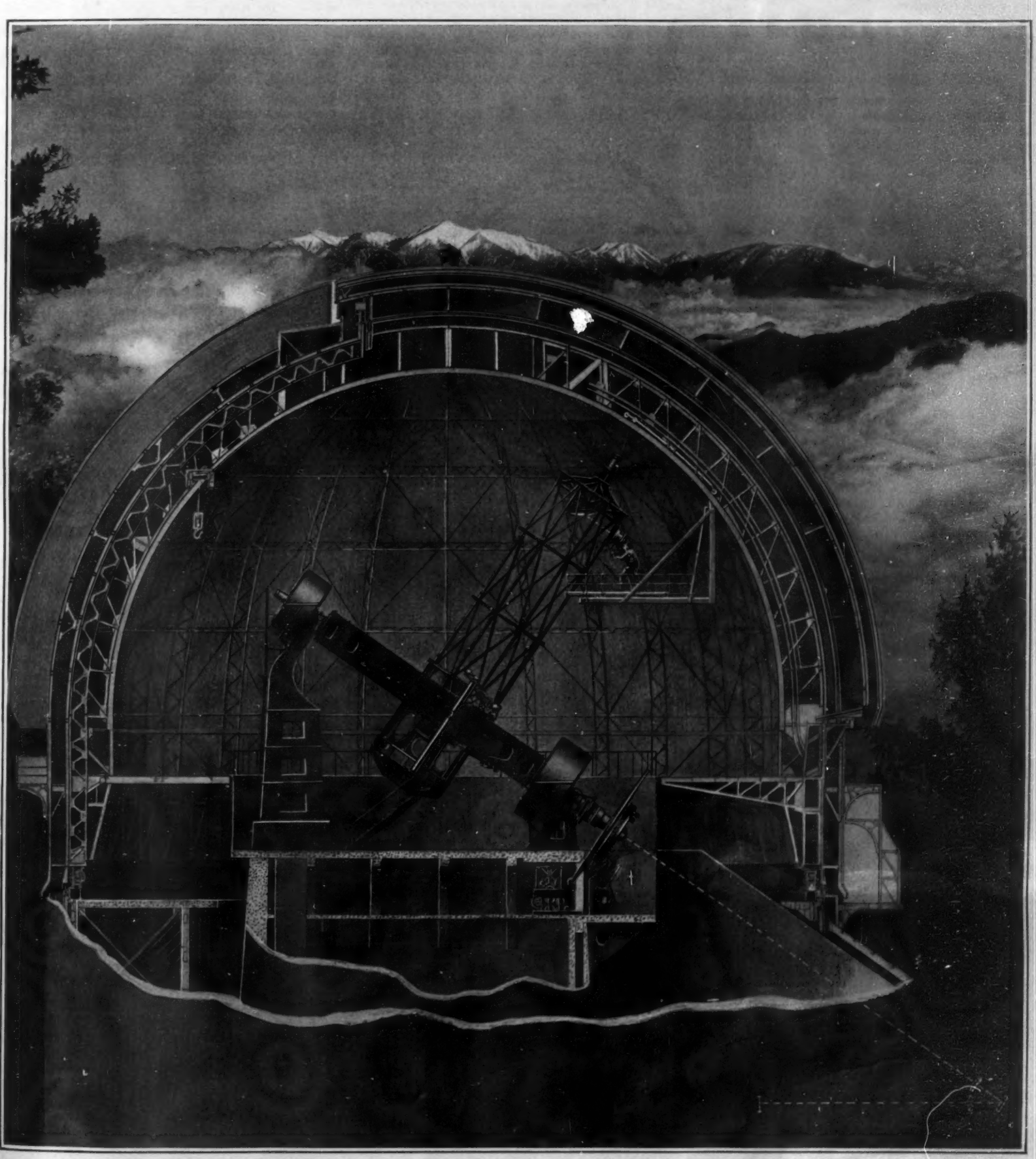
SEVENTY-THIRD YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXVII. NUMBER 6 | NEW YORK, AUGUST 11, 1917 | 10 CENTS A COPY $4.00 A YEAR



UP ABOVE THE CLOUDS—MOUNT WILSON'S 100-INCH REFLECTOR AND THE DOME WITHIN WHICH IT IS MOUNTED—**[See page 100]**

The Newtonian cage with flat and plateholder at side is a separate system from the focal plane cage and spectrograph; both are shown in the engraving although but one can be used at a time. The stationary part of the dome and the pier are correct in outline but not in detail, and the silvering elevator is not shown.

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, August 11, 1917

Charles Allen Munn, President, Frederick C. Beach, Secretary, Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

General Goethals a Great National Asset

ALTHOUGH the American public is not saying much, it is doing some very close thinking about the amazing treatment accorded to General Goethals in the matter of building our new merchant fleet.

The American people are asking themselves why, in getting rid of that arch obstructionist, Denman, it was necessary to sacrifice the most distinguished military engineer in America. Denman, a politician and a non-technical layman, undertook to say what kind of ships should be built for our new fleet. Goethals, a hydraulic engineer and executive of wide experience and unequaled record, believed that the course proposed by Denman would be damaging to the interests of the United States in the great crisis of the present war. Soldier that he is, General Goethals would have been guilty of a grave breach of duty had he not fought against the Denman policies with his whole strength. Doubtless, the General knew only too well that in fighting Denman he was fighting some hidden forces; therefore his brave and uncompromising attitude must be regarded as a fine expression of moral courage and patriotic devotion.

Mr. Bernard Baker, one of the best authorities on mercantile marine in the country, was retired in order to make room for Denman, and the reason for this selection still remains a mystery. Undoubtedly there was general rejoicing over the exit of Denman from a stage upon which he played the part of unconscious, or willful, obstructionist—we leave it to him to say which. He worked out his own downfall in a brief three months; but these were important months and the delay may prove a very serious factor later on in the war.

It was doubtless with extreme regret that the President found it necessary to sacrifice General Goethals, who, it is understood, was his own appointee; but evidently he considered this the simplest way to cut the Gordian Knot. It would seem, nevertheless, that there was due to this able and distinguished engineer some reward for the seeming ill treatment he has received, and that his services should not be lost to the country.

For the builder of the Panama Canal is a great national asset. He is just the kind of able and fearless man of which the country stands so greatly in need during the present stupendous crisis. It will be a monstrous injustice to the man, and will put unspeakable shame upon the country which he has served so well, if he is to go around, hat in hand, begging for some job in which he may be useful during the great emergency.

There must more than one position in which the country could utilize General Goethals' great abilities. First and foremost, there comes to our mind the fact that he is essentially a hydraulic engineer, and that, therefore, he would be preëminently qualified to superintend the task of building the North Sea net. Goethals made good at Panama and he would make good in the North Sea.

In the selection of Rear-Admiral Capps to succeed General Goethals, the President has made an admirable choice. As former Chief Constructor of the Navy and Chief of the Bureau of Construction and Repair, Admiral Capps proved to be an able and fearless executive. His technical ability was recognized in his selection to head the American Committee sent to London to confer on the changes in ship construction called for by the loss of the "Titanic."

The Secretary and the Submarine

IN answer to the question as to when we shall find a solution of the submarine problem, we affirm that this is only one of many problems that will not be solved until our people have ceased to permit their military affairs to be dominated by politicians and professional office-holders—men who are notoriously deficient in broad vision, scientific knowledge and executive experience.

The submarine problem is not a task for such men; it is a job for the engineer, a man of the type that has conceived large and daring schemes, estimated and overcome enormous difficulties, and produced results which have made our country what it is.

We all know what technically-qualified executives have accomplished in building up our stupendous industrial institutions. If one of these were in Mr. Daniels' place, he would make our Navy the most brilliantly effective organization in the world. The officers and men on our ships are not surpassed by those of any navy; but their initiative has been dulled against the inertia of their political chiefs, whose main thought has too often been more of the party than of the great national purpose. Freedom of thought and expression have been so far curbed in our Navy that our highest officers do not feel free to exercise the right even of constructive criticism, so great is the resentment which such criticism has provoked. Independent thought and action on the part of our naval officers are not only not encouraged, they are frowned upon. We all well remember the fate of Admiral Fiske, when he exposed the defects and shortcomings of our Navy. We also remember that the exposure of our submarine inefficiency by Commander Stirling before a Congressional Committee was quickly followed by his removal. The retirement of Captain Potts for a technical reason remains a scandal to this day; for he was recognized as an officer of the highest efficiency and valor. The way to flourish in the Navy is to give no offense to a Secretary, who, by visiting his displeasure upon those who dare to tell him an unpleasant truth (unpleasant in its reaction upon his political fortunes) has put a heavy discount upon honest criticism, and a premium of rapid preferment upon silence and easy acquiescence.

The rank and file of the Navy are fairly itching to be told what to do. But the highest authority is too often in doubt what to tell them; for in any definite policy there lies a certain percentage of political peril. It takes a real statesman to say "Damn the votes," as it took a real fighting sailor to say "Damn the torpedoes." Just as possible votes in California are believed to have held Mr. Denman so long in his place, so by even stronger political ties it would seem that Josephus Daniels is firmly lashed to the rigging of our Navy.

While fine ships, ample ammunition and several new and helpful inventions are in our hands, the real solution of the submarine problem lies not alone in the weapons, nor even in the men to handle them. It lies in the Supreme Authority which alone can plan the attack and sanction the means in its execution. If that man were now in our Navy or England's we would have known it.

The British Navy has been fighting the submarine for three years; but the sinkings have increased at a rate so alarming that it is evident that some more radical measures for combating the submarine must be resorted to.

The direction of the Navy may well be considered the biggest job ever placed in any man's hands. That man can save nations and create a lasting peace, or by failing he can bring about a condition in the United States like that in Belgium and Servia today, where the only man to be envied is the man who is dead.

That is the responsibility which rests today upon the Secretary of the Navy of the United States and upon the President who retains him in office. If the President has the slightest doubt that Josephus Daniels is qualified above all men to cope with the most intricate and technical warfare in the world's history and to organize its defeat, then he personally must accept responsibility if disaster should come upon our country. In certain directions Mr. Daniels has undoubted qualifications. No Secretary of the Navy has ever exerted so much influence upon Congress. He is a man of probity and his manner is genial and attractive; but these qualifications, while useful in a diplomat, are only a fraction of the qualities required in the executive head of a fighting navy.

How long will this state of things continue?

Probably until the day when the front page of our newspapers is filled solid with the names of a thousand or two of our brave boys, who have been drowned by the sinking of a transport. Our people are patient, almost criminally patient; but something like that will be enough to start them, and when they are once aroused they will act quickly and will see to it that the politicians who have most actively helped the enemy by pro-German tactics of obstruction in Congress are definitely branded as the enemies of their country and treated as such. The people, having learned their lesson, will rally to the support of a few strong men; will demand a place for them in the Government, so that they may make possible the winning of the war. The people will demand the placing in office of men whose business careers have been successful and honorable. The participation of such men in Government will be beneficial both to public affairs and to private business.

The extent of the demand for an ousting of incompetent officials would depend upon the degree of public exasperation at that moment. No man can be sure of the future, but we are reasonably certain of this, that the character of Government prevailing in this country five years from now will depend mainly upon the steps taken by the President in the very near future to vitalize our Navy and thereby to end the activity of the German submarines.

The necessary instruments to defeat the submarine campaign are already at hand. They could be assembled in sufficient quantities for effective use during the next few months. The problem, therefore, is not merely the development of devices, it is their combination into a general strategic plan and its energetic execution. We need decision in our "High Command."

When Is Wintergreen Not Wintergreen?

THE foregoing question might be varied almost endlessly. For example: When is syringa not syringa? When is cedar juniper? Did Socrates die of the hemlock tree or the hemlock herb (*Conium*) or the water hemlock (*Cicuta*), otherwise called cowbane? If *Cicuta* is cowbane, how can *Oxypolis* be cowbane? And is *Conioselinum* called hemlock parsley because it is neither hemlock nor parsley—or why?

The plant which rejoices in one invariable and unequivocal English name all over North America is a rare boon to the distracted teacher of Nature-study and to all who would like to have a speaking acquaintance with our common flora. If it is a cosmopolite species and has no aliases anywhere in the English-speaking world, then it deserves a monument.

Reverting to our original question: We were recently shown a specimen of *Chimaphila maculata* and asked for its name. Here is a plant which is at least not overburdened with synonymy in Latin; Linnaeus assigned it to the genus *Pyrola*, but Pursh's name *Chimaphila maculata* has been in use for more than a century. We were thankful for small favors, remembering that there are species which have borne twenty or more Latin names, besides a host of vernacular ones. The inquirer, however, was not interested in Latin, and the name "spotted wintergreen" came readily to our lips. When occasion offered we privately "looked it up," first in Gray's "Field, Forest and Garden Botany," and then in Wood's "American Botanist and Florist." To our chagrin we found no English names but the two applied to the genus—pipsissewa and prince's pine. Fortunately other authorities were at hand. In Gray's "Manual" we recovered our equanimity. Here—and also in Britton & Brown's "Illustrated Flora"—the species is called spotted wintergreen and nothing else. So much for our own comfort.

But what of our friend when he ventures to air his newly acquired botanical erudition in the presence of somebody who enjoys a lifelong acquaintance with one or more of the other "wintergreens," but not with this spotted fellow? When the doctors disagree, who is to decide? And will not one of the "doctors"—your humble servant—run a dreadful risk of being looked upon as an unsafe guide in momentous questions of nomenclature? For all of our eight American species of *Pyrola* are called wintergreen—except when one of them is called shin-leaf. And then there is *Gaultheria*, a quite distant cousin—not even included in the wintergreen family by the latest systematists—which is called aromatic wintergreen and is the source of oil of wintergreen. But it is also called checkerberry and tearberry. And finally there are two more "wintergreens" which are not related at all to the foregoing; viz., chickweed wintergreen (*Trientalis Americana*), also known as starflower, belonging to the primrose family; and flowering wintergreen (*Polygala paucifolia*), likewise called fringed milkwort or gay-wings, belonging to the milkwort family.

If we who live in America and speak American suffer from this terrible confusion, think of the unfortunate foreigner, striving to learn what plants really *do* grow in this country! Was it not a French translator of Cooper who undertook to explain to his countrymen the passage in which one of the novelist's characters ties his horse to a "locust"? In America, declares the foot-note, these insects grow to an enormous size. Large specimens are occasionally filled with lead and set up by the wayside to serve as hitching-posts.

Is the problem beyond solution?

The War and Office Appliances

AT a time when the drafting of hundreds of thousands of our young manhood is about to take place, the question of business reorganization to fill the vacancies caused by employes leaving to join the colors is a paramount one. It is especially in office work that the vacancies will be most keenly felt, for here the workers represent a more or less thorough training in certain lines of work and a knowledge of the business that cannot be possessed by the new employe for several months to come. In order to meet the situation the use of labor-saving machines and devices of all kinds is being urged, so that eventually it should be possible to meet the coming shortage of skilled office help, to some extent at least.

Astronomy

The Royal Astronomical Society of Canada has suffered financial reverses on account of the war. The Canadian Government recently notified the society that it would be unable to renew its annual grant of $2,000, but this decision was afterward modified, and a grant of $1,000 is to be made this year. An active campaign is now under way to secure new members. It would be regarded as a calamity by astronomers throughout the world if the society were obliged to stop publishing its valuable *Journal* and annual *Handbook*.

Cepheid Variables.—The mysterious behavior of the so-called Cepheid variables—*i. e.*, variable stars of the type of Delta Cephei—is at present one of the leading topics of discussion in the astronomical journals. These stars increase very rapidly in brightness from minimum to maximum, and then decline much more slowly, and irregularly. Most remarkable is the fact that these changes in brightness are accompanied by changes in spectral type. A curve similar to the light curve can be formed by plotting spectral type against phase. The changes in spectrum do not, however, proceed at the same rate as the changes in brightness. These curious phenomena open up new possibilities in celestial physics.

Observing in Comfort.—Mr. Russell W. Porter, whose experiments in designing arrangements for eliminating the ordinary discomforts of astronomical observation have already been mentioned in these columns, publishes in the May number of *Popular Astronomy* descriptions and diagrams of all existing forms of telescope that involve the principle of the enclosed observing room and the stationary eyepiece, together with some forms that have not yet been tried. While the equatorial coudé of the Paris Observatory figures in all books on astronomy, the other instruments described are comparatively unfamiliar. The writer suggests several forms of installation for reflectors, and thinks that these would appeal strongly to the amateur.

The Total Eclipse of the Sun on June 8th, 1918, the path of which crosses the United States diagonally from Washington state to Florida, forms the subject of a special pamphlet just issued by the U. S. Naval Observatory. The first part of the publication is devoted to meteorological statistics, furnished by the U. S. Weather Bureau. These show the average weather conditions in the forepart of June at places along the path of totality, including data of sunshine, temperature, wind, etc. The highest hourly percentages of sunshine appear to prevail at Boisé, Idaho. The second part of the work gives detailed astronomical data. There are large-scale maps showing the regions covered by the eclipse and the times of occurrence of its phases in different parts of the country.

Work of the American Meteor Society.—President Charles P. Olivier, of the American Meteor Society, reports that the observations made by the members of the society during 1914 and 1915 have now been completely reduced and are ready for publication as a memoir of the National Academy of Sciences. During the year 1916 the number of observations reported was 10,184, much exceeding any previous year. These were furnished by 44 observers, in 14 states and 4 Canadian provinces. It is interesting to learn that there are nine meteor observers in Wichita, Kan. The abundance of observations furnished by certain members enabled Prof. Olivier to discover and prove the connection between the 1916 May-June meteors and the Pons-Winnecke comet. At Fort Worth, Texas, Mr. H. H. Martin, of the U. S. Weather Bureau, has secured the coöperation of other local observers in simultaneous observations of meteors from different points, as a means of ascertaining their altitudes. The National Academy of Sciences has made the society a second grant to further its work.

The Royal Observatory of Belgium.—An interesting description of this observatory (at Uccle, a suburb of Brussels), under the conditions of the German occupation is given by Mr. F. P. Brackett in the *Publication* of the Astronomical Society of Pomona College. Mr. Brackett was in Brussels in the summer of 1916. One of his fellow-passengers on the trip to Europe was the well-known Belgian astronomer M. G. van Biesbroeck, a member of the staff of the Royal Observatory, who had been spending a year at the Yerkes Observatory. Although M. van Biesbroeck had obtained permission from the German authorities before visiting America, he was stopped at the frontier and has not yet been allowed to return to his work at Uccle. With some difficulty Mr. Brackett secured permission to visit the observatory. It is closely guarded by German soldiers, and the only observations allowed are those for the time service; these must be made at dusk or dawn. The observatory has been under the direction of Prof. Stroobant, in the absence of the director, M. Lecointe, who, as a reserve officer of the Belgian artillery, has been interned in Holland since the fall of Antwerp. He is now living at The Hague, on parole.

Science

The World's Sugar Supply, according to a bulletin of the U. S. Department of Agriculture, is derived annually from over 12,000,000 acres, this acreage being about equally divided between cane and beets. The yield of beet sugar per acre has ranged between 1,800 and 3,900 pounds, while that of cane sugar has ranged between 2,000 and 9,000 pounds. During the decade from 1904-13, the United States led all other countries in the amount of sugar imported and consumed, but not in per capita consumption, in which Australia led, with 112.96 pounds.

A Permanent Aircraft Exhibit is to be established in Washington in the immediate future, under the auspices of the National Advisory Committee for Aeronautics and the Aircraft Production Board. The exhibit will include all kinds of aircraft material, engine parts, sections of planes, etc., both American and foreign, and the aim will be to make it representative of the latest developments of aeronautics. The principal object of this undertaking is to familiarize American aircraft builders and engineers with the newest and best features of aircraft construction, and thus facilitate the building of the new American air fleet.

The Military Geography of the United States is to be presented in a series of handbooks which the U. S. Geological Survey has undertaken to publish, at the request of the National Research Council. These books will give for the several military divisions of the country compact statements in regard to their physical features, leading industries, transportation lines, and other matters of interest to the Army, in a form suitable for ready consultation by officers. The preparation and editing of these books has been entrusted to the committee on physiography of the Geological Survey, under the chairmanship of Mr. M. R. Campbell.

State Research Committees.—The chairman of the National Research Council, Dr. Geo. E. Hale, has addressed a letter to the several state councils of defense recommending the formation, under those bodies, of state committees of research. These committees would undertake, according to local needs and circumstances the development or investigation of natural resources, the promotion of research methods in industries, the correlation of industries with research agencies already existing, etc. Dr. Hale urges that such committees be organized for permanent service to the community, and not merely for emergency service during the war. The general expenses should be provided by the several states, and the committees should be representative of the leading educational and research institutions as well as of industries in which science plays an important part. Such committees would be active mainly through subcommittees assigned to consider particular questions.

Injecting Solutions into Trees.—A Russian journal reports some experiments by V. Liubimenko on the introduction of various solutions into the wood of growing trees. The solutions were introduced through a glass siphon attached to holes bored with an auger, 0.2 inch in diameter and 0.6 to 0.8 inch deep. The successful introduction of the solutions was found to depend upon the exclusion of air from the holes and upon reduced root pressure, accompanied by partial desiccation of the wood. Other things being equal, the drier the wood the greater the amount of the solution absorbed and the wider its spread through the tree. The solutions spread in all directions, both lengthwise and crosswise of the fibers. Such experiments should be undertaken during the hot and dry season, when the desiccation of wood is at its height, and among the species most subject to desiccation are pear, apple and peach. The practical value of such treatment is not indicated by the writer, but applications will perhaps suggest themselves.

Miners' Consumption in Missouri.—In the year 1915 the United States Bureau of Mines published a study on pulmonary disease among miners in the Joplin district of Missouri in its relation to rock dust in mines, the investigations having been carried out by Dr. A. J. Lanza, of the Public Health Service, and Mr. E. Higgins, of the Bureau of Mines. This has now been supplemented by a further report on the subject, issued by the Public Health Service as Public Health Bulletin 85, from which it appears that probably thirty or thirty-five per cent of the zinc and lead miners of the Joplin district are victims of miners' consumption. The mining operations—drilling, blasting, etc.—are done in an exceedingly hard rock, with a silica content of over ninety-five per cent. The fine, sharp dust permeates the atmosphere of the mines, and the disease is due primarily to the inhalation of this dust. Tuberculous infection usually occurs as the disease progresses, being favored by unhygienic living conditions. The incidence of tubercle infection in these cases constitutes a serious menace to the health of the community, and especially to that of the miners' children.

Aeronautics

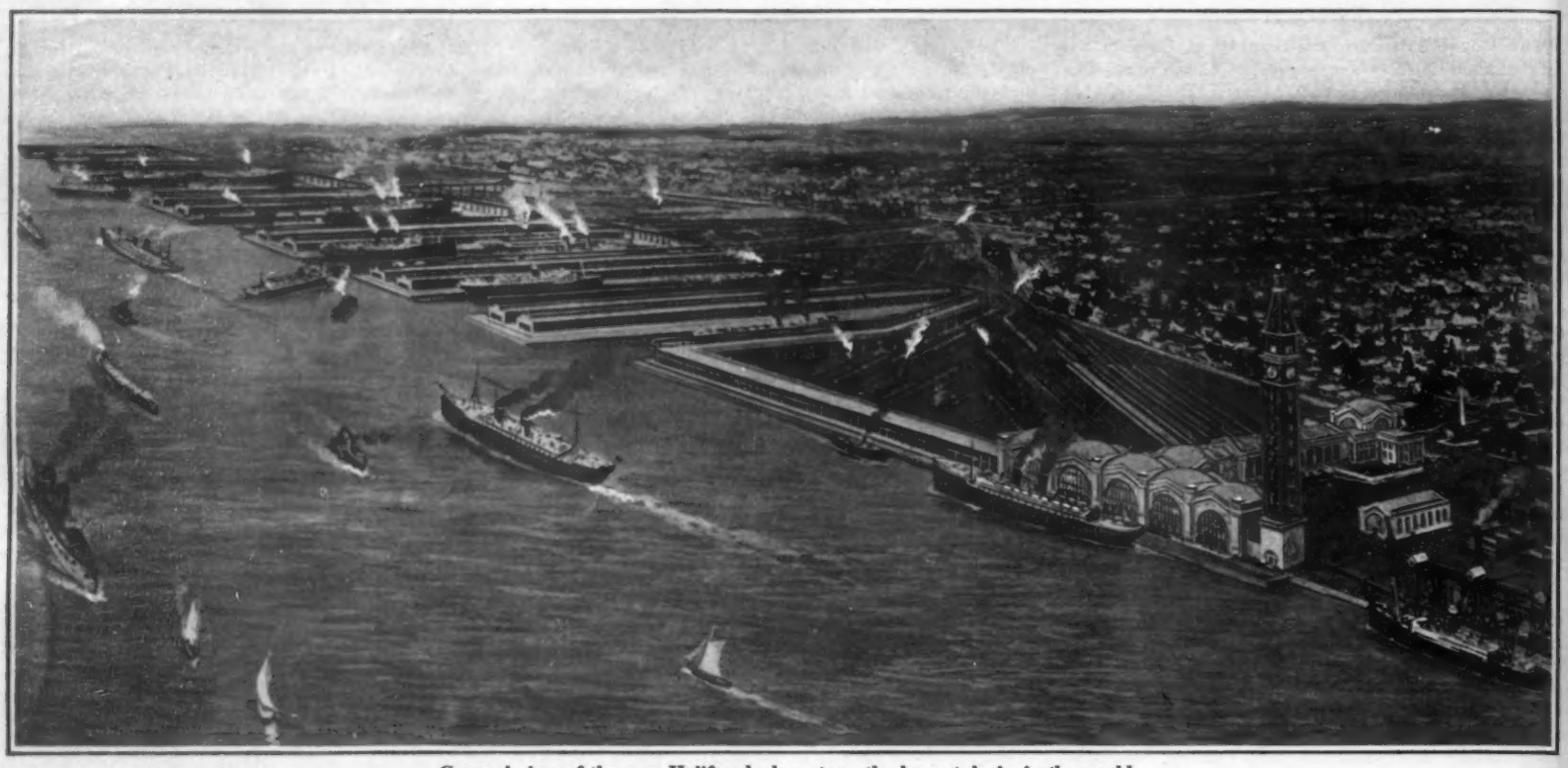
The Big Battleplane recently constructed for the British Admiralty by Mr. Handley Page, while not as large as the huge 1,200 horse-power Curtiss triplane delivered to the Admiralty, is still of good size. It has a span of about 98 feet, a length of 65 feet, and a height of 20 feet. Seats are provided for five people, and mountings are available for three Lewis guns. The craft is propelled by two 12-cylinder Rolls-Royce motors of 280 horse-power. During a recent flight this Handley Page battleplane carried 20 passengers and pilot to a height of 7,180 feet.

Fighting on Three Different Levels.—In describing the work of the airmen at the front, Major L. W. B. Rees of the British flying corps, stated recently that the British fly on three levels with three kinds of machines. The lowest are the artillery directors, who circle about in big figure eights some 6,000 feet above the enemy trenches and flash back directions to the British gunners by wireless. Above them at 10,000 feet, are the heavy fighters with two men to a machine and able to keep the air for four hours at a speed of 110 miles per hour. At a height of 15,000 feet are the single-man, light fighters, capable of 130 miles an hour and of ascending the first 10,000 feet in ten minutes.

Emergency Rations for Air Service.—During a discussion in Parliament recently the First Lord of the Admiralty was asked what arrangements, if any, are made to supply pilots of aeroplanes and all airmen bound on long-distance oversea flights with emergency rations and with facilities for obtaining drinking water when flying in machines with air-cooled motors or for tapping the radiator for drinking water in machines with water-cooled motors. In answering the question Dr. Macnamara stated that emergency rations, consisting of malted milk, Bovril and chocolate are supplied to Royal Navy air stations for the use of pilots of seaplanes and airmen engaged in oversea flights. Drinking facilities are provided for by the issue of thermos flasks. No facilities have been provided for tapping the radiators of water-cooled motors, the contents of which are more likely to act medicinally than otherwise.

What the Germans Think of Rival Air Services.—In a recent interview with a Dutch journalist, General von Hoeppner, Commander-in-Chief of the German Air Service, stated that the German aviators have won the supremacy over their enemies, although the Entente airmen on the Western front were numerically superior. On the Eastern front, however, Germany is rather stronger, while in the Balkans the balance is again in favor of the enemy. The British, he said, showed in air fights that they are of the Germanic race, for they seek fight, and fight until either they or their opponents are killed. German aeroplanes generally are better than those of the enemy, though the new English Sopwith triplanes are excellent. The technical preparedness of the French he described as middling, and that of the British inferior. "While we Germans consider every flight as a military act," stated the General, "for the British flying is but sport, and, when it comes to a fight, good sport. The German is a soldier first. Our German military training cannot be outdone by Britain's three years' war-waging."

Queer Camouflage of German Aeroplanes.—Writing recently of the German fighting aeroplanes, Percival Phillip of the *Daily Express*, states that the Germans are resorting to the most vivid hues in camouflaging their machines. "It is like going out to fight birds of paradise," he was told by one of the R. F. C. pilots, who complained facetiously that the dazzling tints of the Albatros and Aviatik machines nearly blinded him. Never has there been such an orgy of kaleidoscopic effects on the earth or above it. The Hun has taken to daubing his machines fantastically, after the manner of a savage who hopes to frighten his foe to death. A child let loose with a box of paints could not achieve more lurid results. One British aviator who went out one morning to search for trouble found it with a red body and wings that were green on top and blue underneath. One German squadron encountered recently was composed of machines painted white, red and green and one of khaki color, with greenish grey wings. Individual fliers have included a green aeroplane with a yellow nose, another with a red body, green wings, and yellow stripes, another with green body and yellow wings, another with scarlet body, brown tail, and reddish brown wings, with white crosses on a bright green background, another with yellow body and red wings, with light white markings, a machine with one green and one white wing, and others with silver disks, yellow noses, and blue tails. "It seems just possible that the boche pilots are experimenting with colored aeroplanes," remarks the editor of *The Aeroplane* in commenting on Mr. Phillip's despatch, "to see whether varying colors have any effect upon the range-judging powers of enemy pilots, or whether the use of brilliantly variegated stripes cramps their vision in some peculiar way. Startling primary colors in close proximity are distinctly trying to the eyes."



General view of the new Halifax dock system, the largest docks in the world

Halifax's New $30,000,000 Docks

By John F. Stephens, Jr.

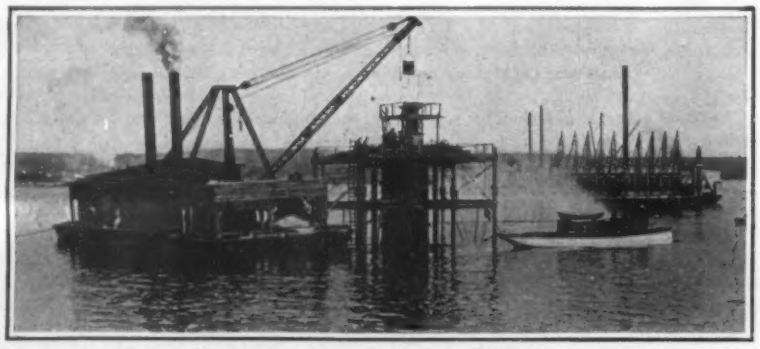
THE largest docks on the American continent are now nearing completion at Halifax. These docks were constructed for the Canadian Government by American contractors. The work was begun in 1914 and will be completed by January 1st, 1918. These docks are so tremendous that two ships the size of the "Olympic" and "Mauritania" could dock end to end at the pier in front of the passenger station.

Halifax is an ideal place to ship from, either during war or in time of peace, as it is open the year round and by reason of its geographical location, shortens the trip across the Atlantic from two to six days, according to the speed of the boat. The "Olympic" has made Halifax from Liverpool in less than five days while it takes her over six to reach Boston or New York.

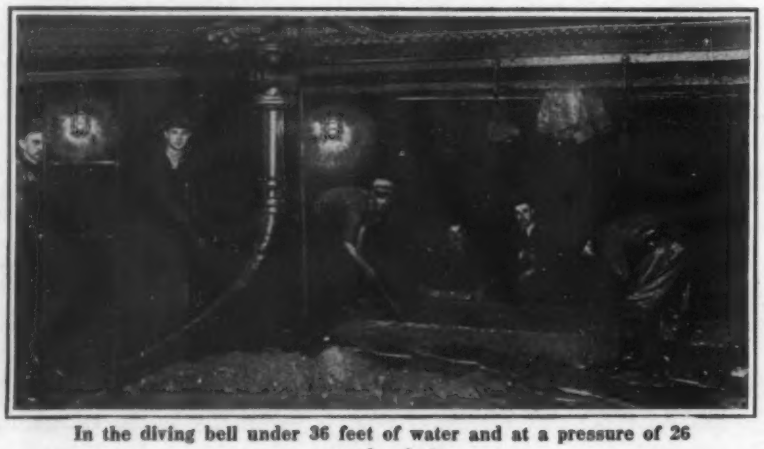
The construction of these immense docks has called for great ingenuity upon the part of engineers and contractors. The work is unique, for a large portion of the equipment was specially designed and built for this undertaking.

The docks are formed of concrete reinforced with steel. To avoid the enormous cost and delay in building coffer dams, the contractors designed and built a great diving bell which is lowered along the foundation line of each dock. A group of men in the diving bell work on the bottom of the harbor cleaning away the muck and rock and preparing the foundation for the huge concrete blocks. The men in this bell work under from 36 to 40 feet of water and at an air pressure of 26 pounds to the square inch.

The dock walls are constructed of concrete shells 31 x 21 x 3 feet. These shells are cast with steel reinforcing and when thoroughly hard are removed by a giant crane with a lifting capacity of 150 tons at a radius of 14 feet, and placed in position under water. These concrete shells might be compared to immense hollow tiles used for building. They weigh about 65 tons each and it requires a stock of 13 of them to form a section of the lock wall. These concrete squares are spoken of as shells because there are 15 openings left through the center and six small openings along the sides. When the shells have been placed in position these hollow cores are then filled with concrete from the bottom to the top through the entire 13 shells which have been placed one upon the other. The combined height of 13 shells brings the wall about three feet above high water and from this to the top of the wall granite rock is used. Steel nails are driven through the holes left at the edge of shells, thus reinforcing the binding of the shells.



Moving the diving bell to a new location

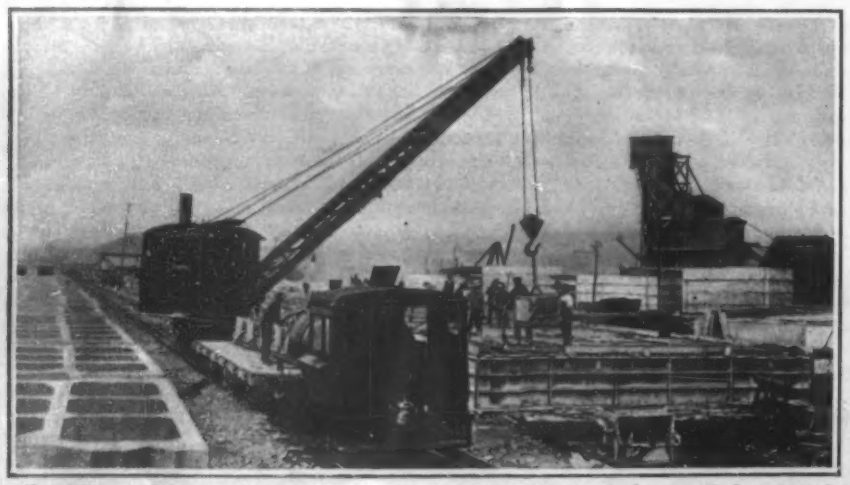


In the diving bell under 36 feet of water and at a pressure of 26 pounds of air

Comparing these shells to bricks, they have moulded upon the face a V-shaped groove so that when the next sections of shells have the V-shape in side or face a square hole is formed. A concreted pile is driven into this hole through the entire 13 shells used in the foundation, thus locking the wall sections together.

About fifty vessels of 7,500 tons can dock in these docks at the same time.

Now that the United States has entered the war with the Allies, these docks are open for Uncle Sam's use should he desire to take advantage of them in shipping men or munitions to France. Although all the docks are not yet completed and will not be until January 1st, 1918, enough of them are finished to offer great docking facilities to Canada and the United States. While it requires two days to reach Halifax from New York, Philadelphia or even Boston, still this time is more than made up by the shortening of the ocean crossing and offers the advantage of making part of the journey safe from any possible enemy attack.



Pouring concrete with a huge crane to make shells like the finished ones piled at the left

Loading the shells on cars

Convoying transports within two lines of overlapping nets, towed by gunboats. The towing vessels are protected by the overlap of the net ahead. Ahead and astern of the column of transports and on each side of the nets is a numerous destroyer patrol

The Submarine Problem—XI.

Protecting a Convoy by Overlapping Lines of Towed Nets or Plates

ADMIRAL GLEAVES' report of the attack on our fleet of transports seems to indicate that the German U-boats managed to get in among the ships of the convoy. Had the attack been made by day, it is probable that the convoying warships would have detected the enemy before he could get so close and driven him off. The darkness of the night, however, affords ideal conditions for submarine operations; and, if the U-boat commanders had the necessary information as to the position, course and speed of our convoys, they would endeavor so to dispose their boats that they would intercept our ships some time between twilight and dawn.

If the thing could be done, there would be no better protection against such night raiding than the method which is shown in the accompanying illustrations; for, under such conditions, a successful attack could be made only from dead ahead or dead astern, and a sufficiency of destroyers preceding and following the column of transports should prove sufficient to render them practically immune from torpedo attack.

This view, looking aft, shows the tail end of the first line of protective plating; the towing vessel at the head of the second line; and the transports steaming in line ahead

The plan to protect a convoy by towing on each flank a continuous line of overlapping nets or steel plates, is not new, and has, indeed, been several times suggested to this office by correspondents both in this country and abroad. It is proposed to have nets or lines of plating, about a thousand feet in length, each line being towed independently of the convoy by its own destroyer, gunboat, powerful tug, or other suitable vessel. In keeping station, each towing vessel would endeavor to steam inside and abreast of the after end of the protective line ahead of it—a disposition which would give complete protection to all the towing vessels, except the one at the head of the leading line. The protective line on each flank of the convoy would be towed at such a distance from the transports as to prevent the submarines from diving beneath the nets and coming up abreast of the protected ships at a sufficient distance to be safe from gunfire.

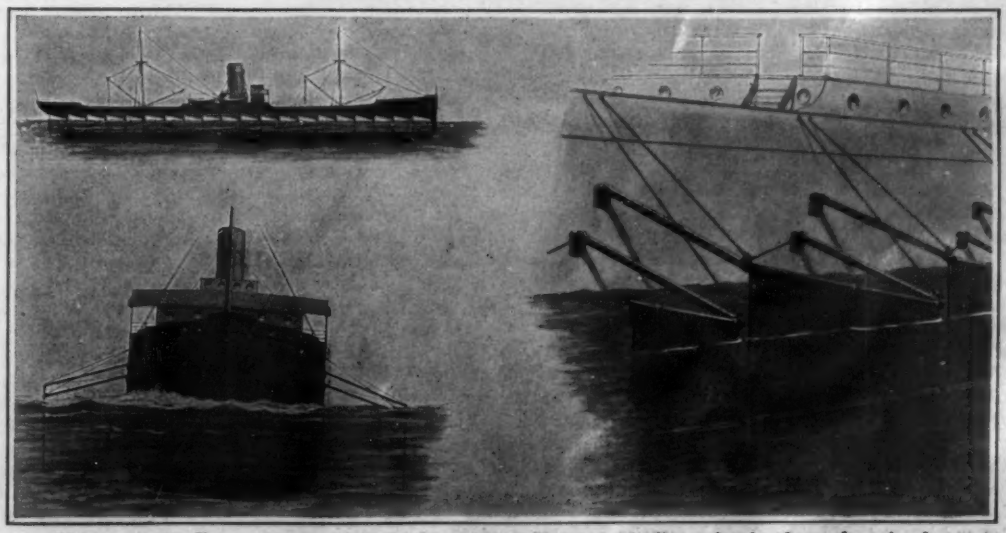
All of the towing vessels would, of course, be armed, and the one at the head of the leading line, being without net protection, would be armed with a heavier and more numerous battery. Every ship of the convoy should carry guns, both forward and aft, and, as we have already stated, there would have to be a strong scouting force of destroyers ahead of the convoy and one or two astern of it, the duty of the latter being to prevent any U-boats from trailing the convoy during the daytime in the hope of closing up at night for attack.

Comprehensively to carry out this method of convoying, it would be necessary to have several convoy units, and the time table would have to be so arranged that each fleet of transports would be met by a convoy unit at the limits of the submarine zone and taken to its destined British or French port, the empty ships being similarly convoyed through the zone on their return trip to America.

Now it cannot be denied that this would be a very ambitious undertaking, and that the task confronting the captains of the towing vessels of keeping proper station and maintaining the necessary overlap during heavy weather, would be exceedingly difficult. But as we have often pointed out in the course of these submarine articles, we must distinguish between the difficult and untried and the impossible.

In heavy weather it would be necessary to widen out the towing line in the lateral direction in order to prevent fouling of the tail end of one protective line with the towing vessel at the head of the next. Also, the speed of the whole fleet would be lowered. Well, let it be lowered for a day or so. It is surely better for a whole fleet of transports to go through the submarine zone though they may be a day or two late intact, even than for it to reach port a day or two earlier at the cost of the possible loss of some thousands of our fighting men.

Because of the enormous amount of frictional and eddy-making resistance set up by a towed chain net, it would be preferable to employ some form of vertical plate protection. We notice that this fact has been pretty generally realised among our correspondents who have sent in their various suggestions. The advantages and limitations (chiefly the latter), of protective devices towed by the ship itself we dealt with in Chapter No. III of our Submarine Series, which appeared in our issue of June 16th. It was shown that there was difficulty in persuading steel plates to remain in the vertical position and not swing up toward the surface of the water while they were being towed at any reasonable speed. This tendency was sought to be overcome in one design



Ship protection by a system of steel plates that will automatically maintain themselves in the vertical position

(Concluded on page 107)

Strategic Moves of the War, August 2nd, 1917

By Our Military Expert

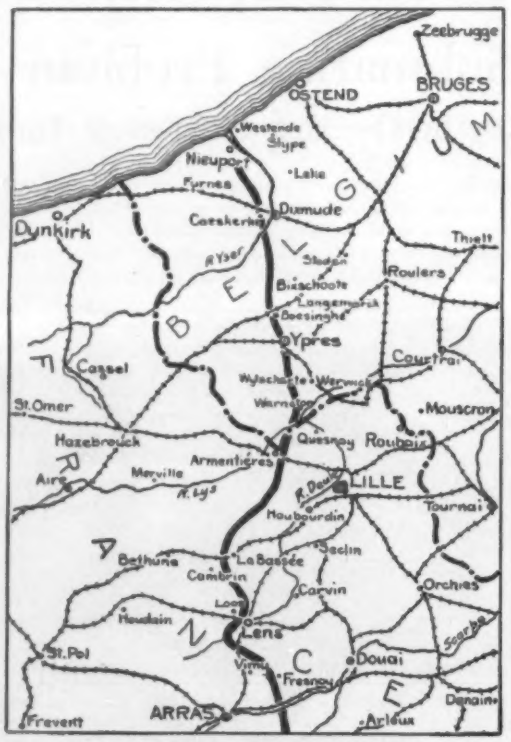
THE recent Russian offensive had awakened in all who have desired an Entente victory great hopes which the present debacle—now existing for ten days or more in the Russian Army—has shown to be unreasonable and ill founded. It had been quite generally recognized—even before the fall of the late Czar—that Russia might be out of the war; this feeling had grown despite Brussiloff's successes of last summer. The offensive and temporary successes of two weeks ago had made many believe that Russia had come back and her reentrance was hailed with the greatest delight by her hard-pressed Allies in other quarters. But even now, though her efforts may have failed and her military power on the Eastern front may have collapsed, she has yet rendered great service in the gigantic struggle against German militarism. For, had such a collapse occurred at the beginning of the war or even two years ago before England had formed her great armies, who knows where the world would have been today? England's thousands and our own armies added to England's strength and that of France on the Western front, will still hold the balance of power, no matter how many German troops may be withdrawn from Russia to fight on the western lines.

While the Allies have suffered reverses in every form and at many points, it must be borne in mind that Germany also has had her bitter experiences. Her best troops, the pride of the Fatherland and the pick of her manhood, have gone. She has endured hardships and privations that only now are beginning to be felt by France and England; the commercial and industrial supremacy in the world that she has so long and so carefully fostered and built up is now doomed and it will not be long before the German people will have fully awakened to their suffering and its causes, especially as there is now before them another winter of carnage and deprivation. On every side it must soon be borne in upon them that there is no hope of winning the war. The battle of the Marne rendered ultimate German defeat inevitable, however long it may be delayed. The drives to Paris and along the coast to Dunkirk and Calais early in the war were failures; the drive at Verdun, when so many thousands of her best troops perished, was also a failure. The long continued struggle on the Craonne plateau is gradually leading to a failure. There is every prospect that the early forward movement now begun in the British and French sectors will lead to greater successes than those recently achieved on the Somme and around Arras and Messines Ridge.

But another side to the picture is presented when the conduct of the Russian troops on the Galician front is considered. Here are seen thousands of troops who, but a few days ago, were filled with high hopes and flushed with victory and who are now betraying the most astounding insubordination and cowardice; entire armies have fled like poltroons before their German adversaries, abandoning in flight arms, guns, food, and military stores in abundance. What has caused these sudden revulsions in the physical and mental temperaments of a supposedly trained and disciplined body can be attributed only to the dense ignorance of the Russian masses, which ignorance has been played upon by socialists, anarchists, and German spies and agents, and has now brought Russia to the verge of ruin. It may be possible to avert the dangers and the recent summoning to Petrograd by the present Russian government of Generals Alexieff, Ruzsky, Gourko and Brussiloff shows early efforts to reorganize the Russian armies and to begin new plans of defense. If Kerensky, practically the present dictator in Russia, can successfully meet present conditions and can turn the tide now running on that front so strongly in Germany's favor, he will have proved himself one of the world's greatest men.

While awaiting what can be done in Russia itself to hold out against recent disasters, there will devolve upon the Entente Allies new duties and obligations to repair the enormous injuries that have been done to their own interests here and in other fields due to the Russian collapse. It has been surmised that the Saloniki campaign might be given up and General Sarrail's army withdrawn, to be held when needed in Italy and on the Western front. So far a decision seems to have been reached, however, only to end the military occupation of the parts of Greece, Epirus and Thessaly that have been held by the Allies and to transfer all civil and other authority to the Greek government. These withdrawals will in no manner influence for the present the status of the military operations on the Macedonian front and in southern Serbia. In fact, even if military exigencies should cause a demand for the general abandonment of an offensive campaign along these lines, it is not seen how the Entente Allies could willfully abandon poor Serbia to the tender mercies of the Turk, Bulgar, and German and could give up all idea and intent to aid the country that has sacrificed so much and has almost disappeared from the map as a separate kingdom. Such a breach of moral faith and loyalty to a faithful ally would undoubtedly react upon those who should urge such a thing and would bring upon them richly merited criticism and condemnation.

Along the Galician front at all the danger points of the Russian retirement, resistance seems to be increasing although the retirement has extended from Brody on the north well along to the Carpathian mountains—a distance of 160 to 200 miles. Everything points to an early abandonment of Czernowitz the capital of Bukowina and to the selection by the Russian commanders of a line of defense running from some point northeast of Tarnopol to Kimpolung just north of the Moldavian boundary line. German pressure may, however, force an evacuation of all Austrian territory and a further retreat into Bessarabia. In fact, the fall of Czernowitz seems certain as the Austro-German columns are closing in on it from two directions: on the northwest they have reached the junction of the northern Sereth River with the Dniester and on the west they have reached Kuty, 35 miles away. The results of the Russian defeat show now the abandonment of Galicia, possibly all of Bukowina and also of a large area of what is known as White Russia. Their columns are already over the border at Husiatyn on the Zbrocz River southeast of Tarnopol. South of these points the Russo-Rumanian offensive movement is developing and advances up the Putna valley to the east of the Transylvania Alps have been made; but all these can have but little effect on the continued catastrophe farther north and can aid only in straightening the Russian lines. As it stands, however, the movement is highly creditable to the reorganized Rumanian army, since it drove a wedge nine miles deep into the enemy's lines, and the territory already taken by it is more than twice what was gained by the British as a result of the battles around Messines Ridge. But, as a whole, it has not greatly lessened the pressure against the routed troops to the north who are now retreating over unprepared country with many of the vital lines of communication destroyed.



Scene of the Allied offensive in Flanders

It would seem as if the present military status on this front well warrants the criticism of a distingushed German military critic, when he says: "Without its monarchy democratic and revolutionized Russia has lost its firmness. If we understand how to utilise Russia's political position and decay we may harvest what brings peace nearer to victory." These are ominous words and it can only be hoped that they may not prove true in the end.

On the Western front what is officially admitted as the great artillery battle of the war has been taking place in Flanders in the last day or two; it follows two weeks of almost unprecedented bombardment and has been termed—"the highest degree of massed effect in the war." So great has been the artillery fire that it has been heard in London. The front over which this has occurred extends from the Belgian coast to the French frontier, a distance of 33 miles; the artillery fire over such a distance must represent an enormous concentration of light and heavy guns and an incredible expenditure of ammunition; numerous raids and tentative thrusts all along the Western front were highly significant and showed a nervous tension in the lines. The material damage of such moves is in general small but the information obtained is often of great value. As a result of the preparation referred to the English in conjunction with the French troops on their left serving on the Belgian border attacked the German positions on a 25-mile wide front north of the River Lys. The artillery preparation is said to have been of the most intense kind and was the greatest barrage fire ever seen during the war. From near Armentieres on the Lys to Dixmude on the Yser the British and French infantry broke through the first lines of defense to a maximum distance of two and a half miles. As this is only the beginning of the drive, its ultimate importance cannot be gaged as yet; but its moral effect is greater than any other military movement of the present year. Whatever may be the objective it is evident that the fate of Lille, Roubaux, and Tourcoing, the three great industrial towns of northern France, depends on the success or failure of the present drive.

Just now it would appear that the weakest part of the German line is its right flank toward Belgium and the North Sea; if that flank can be broken or turned, not only will the U-boat bases be wiped out but the flank of the German army in France would be turned. If such an advance could be extended to the Dutch frontier so that Holland could be protected, it is believed the latter country might join the Allies. It is understood that Germany has for some time feared such an outcome and for that reason has held a large body of troops near the Dutch borders ready for an emergency. One note made is worthy of careful consideration: the Entente military officials say that the morale of the German troops is by no means up to the old standard. This bears out what has heretofore been stated in these reviews—that the best troops of the original invading army are now used up and the recent levies cannot be so thoroughly relied upon to stand up against the heavy pressure of the trained French and British forces on the western lines.

There have been attacks and counter attacks on the French front along the Craonne plateau and the Chemin des Dames, around Tahure in the Champagne, and also northwest of Verdun. In general, the advantage appears to have been on the side of the French though both sides have claimed successes.

But little has been heard recently of any military operations on the Tigris and in other parts of Mesopotamia, due to the intense heat of summer in these regions, with the discomforts that accompany it. Little can be expected until cooler weather comes. The same remarks apply to Palestine where the Turks are supposed to have a large army opposed to the British along lines from the Mediterranean coast through Gaza to and beyond Bethsheba and the Hedjas railway. If it be true that the German General von Falkenhayn is now in Palestine, as an illustration in a recent German newspaper shows, and if it is the intent that he is to take command, as reported, in Mesopotamia with a view to a recapture of Bagdad, the outlook for the British advance up the Tigris is not so promising, especially as the recent troubles in Russia will no doubt have great influence upon the movements of the Russian forces in Armenia and of those that have been acting from the direction of Persia to assist the British in their advance on Mosul.

The principal topics of interest during the past few days have been the very indefinite suggestions of the Imperial German Chancellor as to a basis for peace, which seems to have been meant for home consumption as much as for feelers to try out the tempers of the Entente Allies and to wrest from them some expressions that might aid in splitting unity of action between them. It seems to be quite generally acknowledged that the Entente Allies will never allow the Central Powers to have peace until the parts of France now occupied, Belgium, Luxemburg, Russia, Serbia, and Rumania are restored and until Austria is dismembered upon the lines of the nations making up this heterogeneous empire. If this is done, then Germany's dream of a "Mittel-Europa" empire is at an end. All the Entente powers are determined that the Central Empires shall pay for the destruction carried out in their territories and this makes peace impossible until guarantees are obtained that France, Belgium and Serbia shall receive indemnities for injuries done them. On all these matters the Chancellor has been strangely silent and it is almost needless to say that peace proposals without some such conditions attached would at present receive no official notice from the principal Entente powers. So far as Germany is concerned, it must be by this time realized by those in authority that all hope of victory in the end is now gone. The proud and unyielding tone of assertion so characteristic of Germany is now gone.

A Place For Everything

The Problem of Supplies and How It Is Being Handled by the Storage Committee

By C. H. Claudy

"NOW you've got it, whaddye goin' to do with it?" The slang phrase represents so accurately the problem which arose with terrifying suddenness when the United States entered the war, that no fitter statement of the *raison d'être* of the Storage Committee, of the General Munitions Board of the Council of National Defense, can be imagined than to say it exists to answer that question.

The United States is accustomed to looking after an army of something less than a hundred thousand men, mostly in this country, and of taking care of it slowly, deliberately, at leisure. Suddenly faced with the problem of an army of indefinitely increased magnitude—of creating almost over night one which is certainly to be more than half a million and may well be several million men in strength, and of taking care of it not only at home but abroad, it is easily understood that existing methods will not work smoothly and efficiently under the new and greatly enlarged conditions.

The problem is so big it is difficult to state in its entirety—it is very doubtful if any one in the Government really knows just how big that problem is. The fighting forces have seven branches, all of which are engaged in the supply business, and the nation, as a whole, two more to add their mite of confusion to the list.

In the popular mind, the Quartermaster Corps is the supply corps of the Army. And so it is. But the Ordnance Bureau, the Engineers, the Medical Corps, the Signal Service including Aviation, the Navy, the Marines—all have their own supply methods, and the Food Commission and the Red Cross have or will have theirs.

The man in the street reads in the morning paper that the United States has closed a contract for several million pairs of shoes, a million or so tents, a wilderness of tent pegs, enough canned food to feed Belgium for the rest of the year, ammunition enough to annihilate the world, blankets sufficient to keep the army warm, rifles, guns, optical instruments, medical supplies, aeroplanes—everything, and everything in huge quantities.

"That's good," he says. "We are doing this thing *right*."

It never occurs to him to wonder what the United States is going to *do* with all this material when it is manufactured and ready for delivery.

For *something* must be done with it. The manufacturer can't store it. Every inch of space he has is filled with raw material or manufacturing machinery.

The railroads can't store it. They haven't cars enough to move it rapidly, let alone cars enough to keep it in.

The Army and Navy can't store it. They have warehouses and supply depots calculated on a peace foundation. They can take care of the existing organization, but the Army has grown up while we watched and the Navy is sprouting faster than any United States Navy ever sprouted before, and as for the Engineers, and Ordnance Bureau and the Signal and Medical Corps, they are buying as they never have been able to buy in the past and they must store, somewhere, somehow, as they have never had to store before.

But the problem goes a step further than the mere locating of storage space. There is plenty of land in the country and we can run up warehouses at least as fast as they are needed, and probably faster. But warehousing supplies in vast quantities must either be done with the very acme of skill, with the utmost efficiency and the least waste of time, effort and space, or it might just as well not be done. The problem is in getting men who know the job far more than in getting houses, spaces, places, in which goods can be stored.

Hence the Storage Committee, which for weeks has been as vigorously at work as it has been quiet about it, for weeks gathering an organization together, finding the men to do its work, laying its plans, and perfecting its schedule or campaign of work—for the storage problem includes that of distribution, and the work is naturally a progression of steps, as manufactured material flows out from the factory to the storage area, and thence to wherever it is to be used.

Seen as a whole, the problem comprises four great divisions of storage areas. First, at the manufacturing plant, second, at a point of assembly in a manufacturing district, third, at a point of utilization, and fourth, at the terminal ports. Note the use of the word *area*, rather than any more definite word—by no means all storage is accomplished in a warehouse.

With this broad classification for a foundation, the plans of the Storage Committee are built upwards through the delivery problem with efficiency of handling as a slogan. In other words, the railroads must be asked to handle a delivery only *once*. Material must be taken from factory *direct* to one of the four funadmental divisions and not, step by step, through them all, as might happen, for instance, to material designed for shipment abroad.

This seems simple—is simple, in the stating, but to work it out practically with the nine supply divisions of our military and industrial establishment, is a work of such magnitude that the very ablest brains of the country have been called to the colors in the Storage Committee.

The Storage Committee in its many ramifications includes a great many eminent civilians. But the Storage Committee, proper, consists of M. L. Cooke, Chairman, Consulting Efficiency Engineer, associate of F. W. Taylor of "Scientific Management" fame; Charles Day, of Day and Zimmerman, Philadelphia; H. P. Kendall, Plimpton Press, Norwood, Mass.; R. M. Bissell, President National Fire Underwriters' Association, Boston; and H. H. Titsworth, President, Clay Products Company, Indianapolis.

As far as the public is concerned, the Storage Committee has two great aims, both of which are highly important. The first of these is to conduct such a campaign of education as will result in a popular respect for the supply divisions at least equal to that given the fighting arms. It is vital in any great work that public opinion uphold it. Unfortunately, it is not generally recognized that for every man in a trench there are five working for him behind the lines, manufacturing, transporting, storing, distributing and making available the food he eats, the clothes he wears, the gun he shoots, the ammunition he pulls trigger upon, the bed, doctor and surgical supply which help him back to health and strengh when wounded.

The supply divisions are vital to any military success. The supply divisions for the United States fighting forces must have popular recognition, support, respect and coöperation, if they are to operate with the success essential to the Army's success, and not with the terror-inspiring results which might, in so large a military establishment, result from a second embalmed beef scandal like that of the Spanish war or another failure of aeronautical material like that of the Mexican Punitive Expedition.

Not only is popular approval and understanding considered an essential end to be obtained by the Storage Committee, but the enlisting of the interest and cooperation of all business communities is absolutely vital to the establishment of proper storage facilities at the point of manufacture. In peace times a factory dumps its finished product on the railroad with the comfortable feeling "I've done my part; now, I should worry as to when it gets there." The manufacturer sends his product out in half carload or half trainload lots, with no thought of a lack of patriotism. But when every empty car is a crime, when every trainload of freight which is less than the maximum possible represents a treason against the republic, manufacturers must mend their ways. Here is where the interest of the business community comes in. There must be established in manufacturing centers such storage facilities, in which all factories in the immediate neighborhood can have a part, as will enable that community to ship the maximum number of carload lots to a trainload. The summit of achievement here is a definite stated number of cars per day or per week, in order to simplify as far as possible, and make thoroughly efficient, the handling and storing of the manufactured material at its point of delivery.

This, too, sounds simple, but it means a campaign of education, the visits and work of trained men, and a tremendous correspondence. Yet it is being done.

"How is it being done? The Storage Committee, like all the rest of the Council of National Defense, has no authority."

More than one man, reading the many unjustifiable criticisms of the Council of Defense which have been made, sometimes by honest men, more often by demagogues seeking political advertisement, has asked this question. It is a great pity he can't ask it personally of Mr. M. L. Cooke, Chairman of the Storage Committee.

"Authority? I've all the authority I can use!" he would answer it. "Not perhaps, the kind of authority the business world possesses. I can't *order* any one to do anything. But I never do, anyway. What more authority does any one need than facts—than experts to find out facts and lay them before those who *have* authority?"

And that is the way this work is being done. For instance, in one branch of the armed forces of the United States were no less than five separate divisions, each one of which operated a complete supply and storage business. That complicated condition had been the result of a slow growth. As a new need arose, a new division was created to take care of it, just as bureaucracy always does become fruitful and mulitply. No one saw the clumsiness, top-heaviness, lost motion and red tape of five sets of men doing exactly the same thing for exactly the same people, merely operating with different material. But the Storage Committee saw it, marshalled a few facts, laid them before the man who had the authority—and the five were consolidated into one.

Not very long ago a high official of the Government was considerably beset with men who came to him with storage and distribution and delivery problems. His own force was overworked and he was somewhat at a loss what to do. Finally he came to the Storage Committee and asked them to recommend a large number of men who could be commissioned as officers to do this work—men in civil life who knew storage and warehousing and distribution. The Storage Committee found the men for him. Now he won't see any one on a problem of this kind unless they have first seen the Storage Committee.

"What more authority does any one want than that?" asks Mr. Cooke.

It may sound strange to military ears, but it is nevertheless a fact that storage and warehousing, distribution and supply are all civilian arts, better understood as a whole by civilians than military authorities. For the military authority is apt to see the question *only* from the military angle, and when a country is being turned upside down with the upheaval of war, it is necessary to see the problem from the standpoint not only of the Army and Navy, but from that of the builder, the railroad man, the hauling contractor, and the man who will route the goods as well as the fighting arms—in fact from the standpoint of all industry. The fact is now well recognized by military authorities.

The Storage Committee started training schools for storage men and have already supplied nearly five hundred non-commissioned officers, who have had a university education and experience in business. The Commerce Departments of Dartmouth College and the Universities of Michigan, Wisconsin, Pennsylvania and Chicago were the first educational institutions to enlist in this service, putting a score or more of their most expert teachers on the work. These training courses last from six to eight weeks, and include both practice and theory. Students are taught packing and unpacking methods, learn to make a temporary storage warehouse out of packing boxes and cases, and study the operation of a warehouse, the drainage of storage areas, the warehouse and storage problems as encountered at the front as well as in and around supply depots. They are shown how to store lumber so it won't topple, coal so it won't ignite spontaneously; and above all they are impressed with that most important principle that what first goes into storage must be so stored that it is the first to come out, so that neither food nor ammunition will grow old, etc., etc. So important has this short course training work been thought by military authority that the Quartermaster Department has designated Capt. R. H. Hess, who in peace times is a professor of political economy in the University of Wisconsin, to have charge of it, and he now has over a thousand men in thirteen Universities learning the purchasing and storage of war supplies and methods of army transportation, finance and accounting.

While it is true that storage and warehouzing is essentially a civilian rather than a military problem, when considered for military purposes it has an angle which only the military man can handle. Hence, a very close degree of coöperation between the Storage Committee and the Army is an essential to its success, and that coöperation is being effected by a separate committee, known as the Depot Board, in which representatives of the Army and representatives of the Storage Committee meet to discuss the work of the latter, plan new lines of effort and check up from the military standpoint on the work already done.

The Storage Committee is so organized that its hundred and one problems are attacked systematically and in order. It has separate subcommittees to consider plant and equipment, method and procedure, and personnel.

Plant and equipment cannot be planned without a comprehensive idea of the material to be stored, its kind, the quantities which have been and will be ordered, how it will be packed and the cubic space needed. Unquestionably the Storage Committee knows, and it is doubtful if any one else in the United States does know, just how much of everything will be on hand at various periods in the future, just where it will be kept, and just how much space will be needed, both covered and uncovered, to keep it. It is impossible wisely to

(Concluded on page 105)

Mount Wilson's 100-Inch Reflector

Gigantic Telescope Mounting That Required the Machinery of a Shipyard For Its Construction

By Francis G. Pease, in Charge of Instrument Design, Mount Wilson Observatory

THE function of a great telescope lens or mirror is not to magnify but to gather light. To be sure the more light it gathers the longer may its focus be and the larger will be the focal image. But the real magnifier is the eye-piece which is a powerful microscope that enlarges the image formed at the focal plane of the great objective.

The objective of the human eye is extremely small. It gathers very little light and hence stars fainter than 6th magnitude are invisible. Only about five thousand stars may be seen with the unaided eye throughout the entire sphere of the heavens. With the 60-inch reflector of Mount Wilson Observatory it is estimated that 219,000,000 stars may be detected, while the great 100-inch reflector, now nearing completion at the same observatory, will probably bring within its range over three hundred million stars.

To be sure, the purpose of the large telescope is not merely the discovery of new stars; as this adds very little to our knowledge of the universe, but there are many problems in astronomy, particularly as regards stellar spectroscopy, upon which the great reflector will probably shed new light. The huge reflector will hold the world's record for size, the next largest being the 72-inch of the Dominion Observatory, Vancouver Island. So gigantic is it that many of the larger parts had to be constructed in a shipbuilding yard equipped with machinery for fabricating the big steel members of battleships. At the same time the work had to be done with the utmost precision. Difficulties of construction were multiplied by having to transport the heavy parts up the steep road to the summit of Mount Wilson. As for the mirror itself, it was necessary to import from France a great disk of glass, 13 inches thick, which, in the rough, weighed four and one-half tons. It has been shaped, polished, and tested by the most exacting methods, in the optical shop of the Mount Wilson Observatory, and will be in service this autumn ferreting out secrets of the sky which have remained beyond our ken for the lack of an eye large enough to see them.

A Hundred-Foot Dome

The mounting of this great reflecting telescope required the construction of an enormous dome, 100 feet in diameter and 100 feet high, beyond which the shutter and the fin project four feet. The lower 28 feet of the dome is stationary and all above this level rotates. The dome is of metal double-walled throughout to preserve a more uniform temperature through the day. Forty massive piers arranged in two concentric rings around the main pier on which the telescope is mounted, provide substantial footings, heavy enough to stand severe winter winds.

The main pier which carries the telescope is of hollow reinforced concrete, and rises to a height of 33 feet so as to remove the telescope from ground radiation at night. A solid wall extends to the south of the pier on the side of which the Coudé spectograph of 30-foot focal length is to be hung. The pier and wall are placed on a bed of sand six inches deep to prevent any vibration of the dome from being felt at the telescope and no part of the dome itself is allowed to touch either the pier or the wall. At the top of the pier is a circular floor 52 feet in diameter and this carries on its outer rim a metal wall rising nine feet to the upper floor of the dome and designed to shut

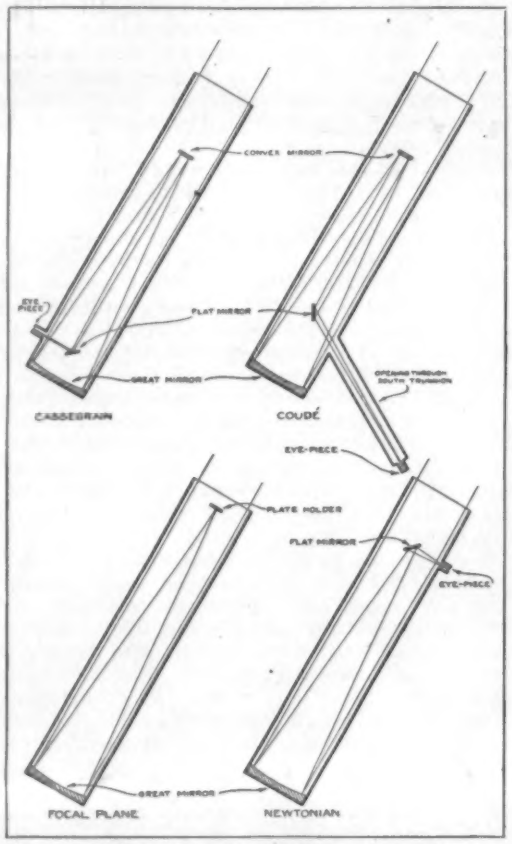


Fig. 1. Various optical combinations used with a reflecting telescope

off air currents between the top and bottom of the dome. Within the pier there is a system of tanks and pumps arranged to maintain a constant temperature system for the mirror, and here are located the dark rooms, silvering room, etc.

English Type of Mounting

The mounting of the telescope is of the English type, in which the polar axis is in the form of a yoke supported on pedestals at either end, while the tube swings in the yoke. The pedestals are made of cast iron, that at the north consisting of five sections.

The yoke is a massive structure built of four sections, each weighing about ten tons. One of illustrations shows the yoke as it is being assembled, and some idea of its huge dimensions may be obtained by comparing it with the men who are at work upon it. Before the yoke was shipped to the Observatory it was assembled and the seats for the trunnions and bearings for the declination axis were bored very carefully in line and at right angles to each other. Since the polar axis is unsymmetrical in section the flexure depends upon the position of the yoke with respect to a given plane. To prevent binding a sleeve (A, Fig. 2) having spherical outer surfaces that fits into a corresponding cup in the pedestal is slipped over the cylindrical trunnion. The latter is thus free to turn in the sleeve, to move axially, and, on account of the slipping permitted at the spherical surfaces, to change its alinement.

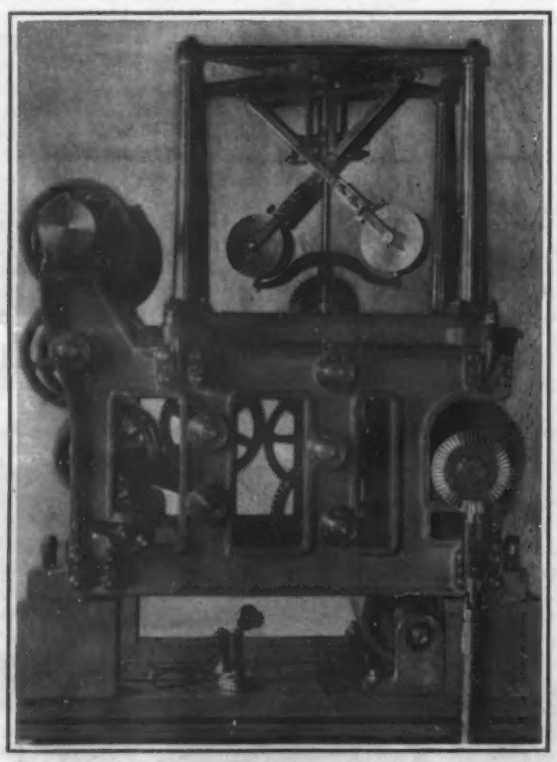
Floating on Mercury

The moving parts of the telescope weigh 100 tons. In order to permit of rotating this enormous mass without undue friction the bulk of the weight is taken up by a flotation system. Forty tons of the weight is taken at the north pedestal and 60 tons at the south pedestal. The displacements are obtained by floating steel cylinders built up in cast iron tanks with less than one-eighth of an inch clearance between them. This is filled with mercury in which the cylinders float. The tanks had to be carefully machined in order to keep the volume of mercury small and to insure freedom of contact with the float. In Fig. 2 a tank is shown at "B" and a floating cylinder at "C." In order to obtain a greater depth of mercury a steel sleeve "D" is firmly fastened to the south half of each tank thus bringing the level about two feet higher in each tank. As the different cages and attachments of the telescope have weights differing by several tons a plunger device is installed to adjust the mercury to any desired level.

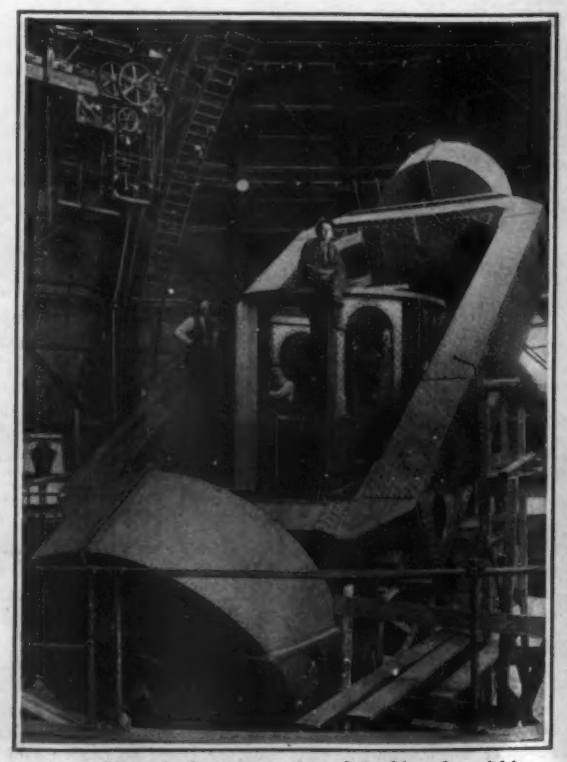
Cutting a 1,400-toothed Worm Wheel

Mounted at the lower end of the polar axis is a worm wheel "E" which meshes with the driving train of the clock "F." This wheel has 1,440 teeth very accurately cut to avoid periodic error. After assembly in final position on the telescope the graduations of an accurately divided circle were transferred to a brass strip in the rim and checked to $\frac{1}{1000}$ of an inch. The teeth on this worm were then cut while the wheel was in position in order to insure accuracy. As we have just stated, the polar axis bends differently in different positions carrying the worm wheel with it. It was therefore necessary to cut the teeth in the wheel so that there would be no binding. Consequently five cuts were made to form each tooth and give it bottom; next it

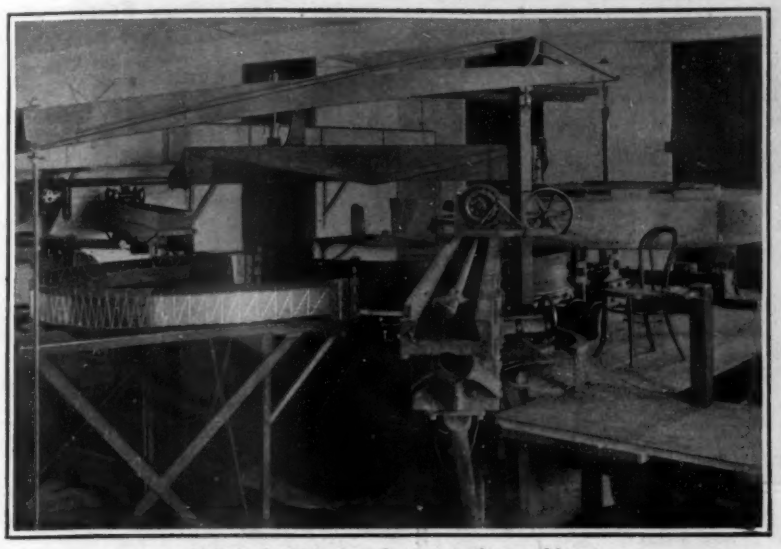
The north pedestal which carries the upper bearing of the yoke frame



The clock that drives the 100-ton telescope. Note the telephone instrument as a scale of dimensions

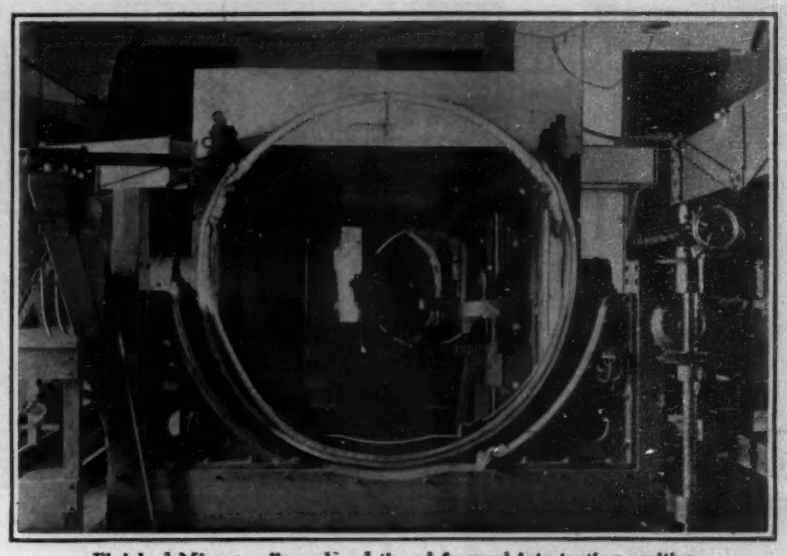


Assembling the bottom section of the big tube within the great yoke frame



Polished 100-inch reflector on the machine

The full sized polishing tool is swung to the right side. The edge band that supports the glass when tipped forward for testing may be seen at the left side.



Finished Mirror—silvered and tipped forward into testing position

Reflections show photographer's camera, a testing stand for the Cassegrain mirrors and the 5-foot optical flat that was used in testing the 100-inch mirror.

was hobbed centrally at two settings off center at each side. The ends of the tooth were cut back with a hob of large diameter. Similar operations were carried out during the grinding. At the present time variation in pitch is less than $\frac{1}{10000}$ of an inch. The final grinding will be done with all parts of the telescope in position, and the instrument set in steps of 10 degrees for 90 degrees east and west of the meridian.

The Clock That Drives the 100-Ton Telescope

The relative position of the driving clock is shown in the drawing. A better view of it is given in the photograph in which an ordinary telephone instrument has been placed to serve as a basis of comparison of size. The clock is driven by a massive weight which tips the scale at 1½ tons, and the speed of falling is carefully regulated by an isochronous governor of the conical pendulun type. The weight is wound up automatically at intervals of 12 minutes; the rewinding being done without affecting the driving of the clock. The clock itself stands six feet high and occupies a floor space of 5½ by 4 feet. It connects with the driving worm by means of a double universal joint. The tube, which is mounted within the yoke, is 11 feet in diameter and within one inch of 35 feet long. On this are added cages measuring from 5 feet, 5 inches to 10 feet, 3 inches. All sections of the tube were placed in the boring mill and machined true to size so that upon assembly the tube as a whole would be strained uniformly.

Optical Combinations

In Fig. 1 are shown the various optical combinations that may be used with the reflector. The mirrors and attachments permitting these combinations are carried by means of steel bands in the cages. The focal plane cage used for photographic work carries the spectrograph and plate holder in the optical axis, all guiding and controlling devices being carried to the side of the tube. The Newtonian cage carries an optical plane mirror in the axis and is inclined at an angle of 45 degrees, throwing the beam to the side of the tube. Here the plate holders and small spectrographs are directly under the hands of the observer. With the Cassegrain combination the convex hyperboloid mirror reflects the rays back to a plane mirror inclined at 45 degrees, thence to the eye-piece and spectrographs at the side of the tube near its base.

How the Mirror is Mounted

The mounting of the mirror requires the greatest of accuracy. The actual diameter of the mirror is 101.2 inches and it has a clear aperture of 100.375, while its principal focus is 507.5 inches, giving an aperture ratio F/A=5.05. It is 12¾ inches thick at the edge and weighs about 9,000 pounds.

The mirror cell consists of two castings, a semi-steel cylinder and a steel webbed plate, and its position at the lower end of the tube is defined with tapered surfaces. A counterweight system is attached to the webbed plate to define the plane of the mirror, and nine counterpoised plates are used to prevent flexure and consequent distortion of the optical face of the mirror. To define the mirror edgewise there are four massive edge arcs resting on knife edges. Below the ribbed plate are two 800-pound lead weights capable of being placed by motor in any position about the axis of the tube and serving to balance any dissymmetry about a plane passing through this axis.

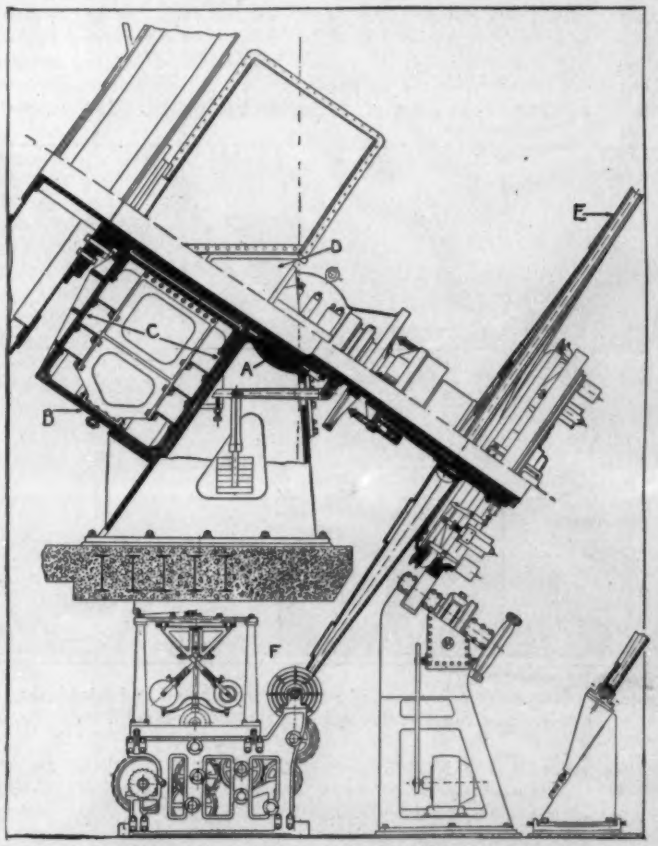


Fig. 2. Sectional view at the south end of the yoke, showing the flotation system and the clock drive

Cutting the teeth of the great worm wheel that drives the telescope

The Mirror Insulating System

Large mirrors are very sensitive to changes of temperature, any change producing a distortion of the figure and a deterioration of the star image. Metals in the mounting and dome rapidly assume the temperature of their surroundings, but the mirror, being of glass, which is opaque to these heat waves of approximately 8-10μ, transmits them only by conduction and consequently takes an unusually long time to follow temperature fluctuations. To keep the mirror at the right temperature or to change gradually this temperature, when necessary, an insulated chamber is formed about the mirror by a wall of one-inch cork board as nearly continuous as the construction of the instrument allows. The cork is placed outside the cell and is protected by a thin sheet metal covering. The insulation continues upward into the inside of the first section of the tube for about a foot and is then carried conically to the under side of the casting carrying the Coudé mirror, on the eight aluminum leaves which form the cover for the mirror. The cover is opened by a motor, the leaves being keyed to shafts and operated by sectors.

Between the webbed plate and the lead weights is a flat coil of thin walled copper pipe connected in series with annular coils directly under the edge arcs, through which liquid of any desired temperature is circulated from large tanks in the pier below. Fans within the cell serve to circulate the air around the mirror and coils. The small auxiliary mirrors are thinner and they have been provided with the cork insulation only.

Resilvering the Mirrors

When the silvered surfaces of the mirrors become dull or tarnished it is necessary to recoat them. For handling the large mirror an elevating column with a large fork on its upper end is raised from the pier and engages in trunnions on the outside of the mirror cell. This column is really a screw, the nut forming the hub of a worm wheel of 5-foot diameter which is carried on a cast iron column by a ball bearing. The tube is guyed to the north and south pedestals and the side members of the yoke to the pier. The cell is next unbolted from the tube and the whole cell, including the mirror, counterweights, etc., weighing about fourteen tons, is lowered into the top room of the pier. Here the temperature may be controlled and the mirror silvered with ease even in winter. The mirror is easily rocked on the trunnions in the fork and the solutions are emptied directly into a draining pan below.

How the Instrument is Controlled

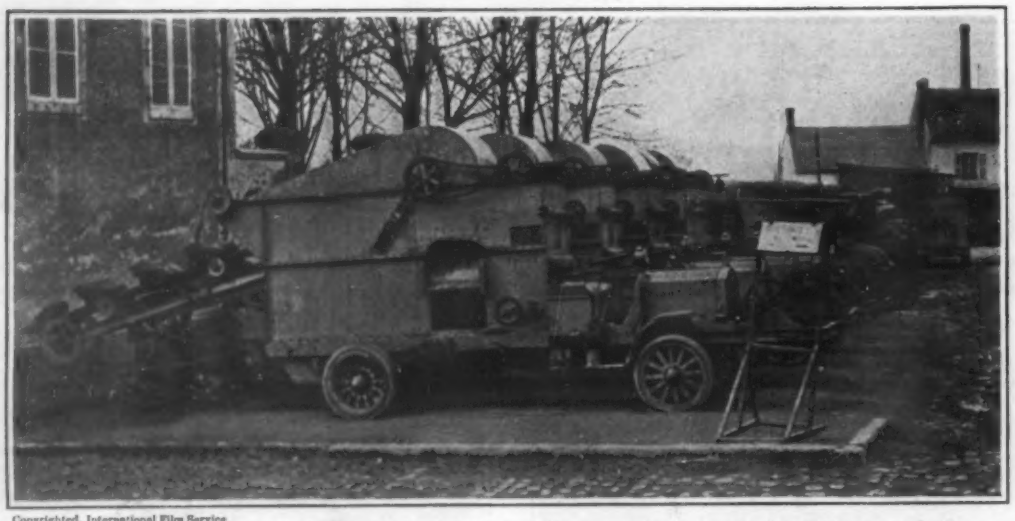
The telescope and dome are controlled and operated from a deck on the pier at the 42-foot level just soutwest of the telescope, to which all circuits and circle readings are carried and where the siderial clock and

(Concluded on page 105)

Digging Trenches by Machinery

IF all the trenches constructed since the opening of the great war were placed end to end, so as to form a single trench, they would more than stretch around the globe at the equator. From modest beginnings the trench systems on the divers fronts have developed into elaborate networks extending hundreds and even thousands of miles.

At first these trenches were constructed by the soldiers; but with the demand for more and more trenches, together with the growing scarcity of manual labor, the British and French soon found it necessary to employ machinery for this important work. It was the French who first saw the possibilities in employing American trench excavators for the purpose, and invited a leading manufacturer of such equipment to study their problem with a view to developing a military type of trench digger. Some time later the American trench diggers arrived in France and were set to work digging trenches behind the fighting line. So successful did they prove in this work that they were made a part of the equipment of every French army group, relieving thousands of men for service at the front.



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A fleet of trench diggers parked in back of the French lines, ready at a moment's notice to go forth and take up their work in new territory

The trench digger consists essentially of a heavy motor-truck chassis equipped with a bucket excavator of the continuous-belt type, and forms the subject of our present cover illustration. It will be noted that the buckets, moving steadily on the belt, scoop up the sand, soil and rock and carry them up to a dumping station, where they are passed out through chutes at either side of the machine. The excavator proper may be tilted at any angle with relation to the horizontal by raising or lowering the free end; and it is so designed that it can readily handle anything from loose sand to rocky soil. The bucket chain is driven by the same engine which

(Concluded on page 105)

Growing Potatoes in Crates Where Ground is Scarce

IN the yard of a large piano manufacturing plant near New York City is a strange farm, even in these days of some two million odd back-yard farms or gardens throughout the country. From a distance one sees a number of crates or pens arranged in rows, which might as well contain pigs or other live stock as potatoes. Yet this odd method of cultivating potatoes is not a new one; indeed, previous records show that a bin 6 by 8 feet can produce 35 bushels of potatoes. The reason for the success of this method is that the plants reach out to the north, south, east and west for air and sunshine, as well as directly upward.

The crate method of growing potatoes has been practiced by the Western miners for years. In many localities in the mining regions only a thin layer of soil covers the rocky ledges, and all the top soil must be brought from a considerable distance. A few loads of precious soil are usually divided among the miners and each man fills a queer pen rather than spread it out over a large surface. The pens are built of timbers in the same fashion as the clothespin houses constructed by children, and furnish open spaces on all sides through which the potato plants force their way.

In cities and congested districts the crate method of raising potatoes is exceptionally valuable. It was for this reason that the piano-manufacturing firm in question prepared careful directions and encouraged its men to plant home farms as well as use the factory yard for raising potatoes. The directions suggest the use of 2 by 4-inch timber and corner posts, rich earth and plenty of manure. The planting is to be done as the building proceeds. Each layer of seed potatoes is allowed 6 inches of soil. The top layer of soil should be sloped toward the center so that the mound will absorb rather than shed the rain. As an additional precaution a piece of timber some three feet long is inserted into the mound from the side, and in dry weather this can be pulled out and the amount of moisture in the heart of the mound ascertained. The adjacent view clearly depicts the method of construction.

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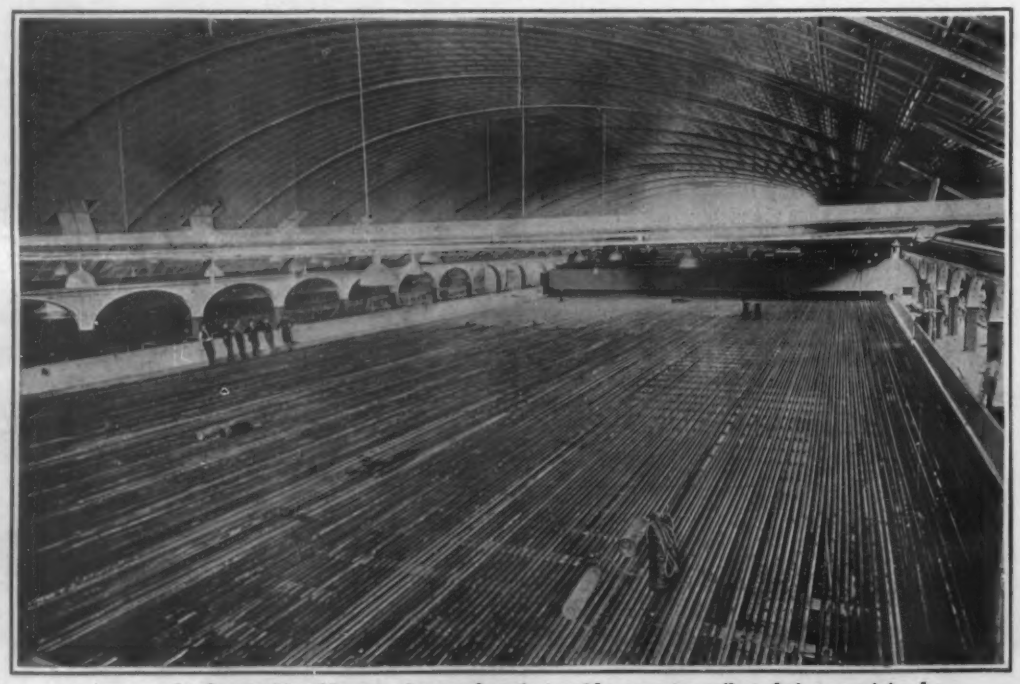
In these crates layer after layer of potatoes are planted and raised, thus economizing considerable space in crowded communities

The potato vines grow both on the top and the sides of the crate, emerging through the crevices at the side and concealing the timbers. When the potatoes are matured the pen may be torn down and the potatoes rolled out of their thin covering of earth with a rake, thus preventing cutting them as frequently happens when they are dug from the hills with a digger or hoe.



As a result of something like two thousand perfect welds, over ten miles of pipe was joined to form one continuous pipe for this skating rink

The Current Supplement

FOR ages men have puzzled over the problems of the universe, and many have looked upon it as a chance collection of dead atoms, propelled by blind force. These problems are considered in an article by an eminent French astronomer in an article entitled *The Nature of Matter*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No 2171, for August 11th. *Muscular Powers of the Human Body* deals with matters of considerable importance at this time, when a great army is being collected in which the physical condition of the men selected is material to its efficiency. It is illustrated by a large number of instructive diagrams. *Weird Diseases of Africa* tells of some of the unusual physical troubles that afflict man in a country that has furnished many mysteries. *The Effect of Weather on Forest Fires* discusses a new phase of the weather problem, with particular reference to California, but which is of wide application, and is illustrated by several excellent photographs. The valuable series of lectures by Sir J. J. Thomson on *The Electrical Properties of Gases* is concluded in this issue. *An Apparatus for Determining Freezing Point Lowering*, as the title indicates, describes an interesting piece of scientific apparatus, and the method of using it. An article of interest to mariners is *Methods of Estimating Distances at Sea in Fog or Thick Weather*, and is illustrated by one diagram. The article on *Rhubarb* tells us something of the history of a valuable food plant, and discusses the question of the wholesomeness of the leaves when used as a vegetable. *Suction Turbulence* deals with a problem of interest in connection with internal combustion engines.

Welding Two Thousand Joints to Make Ten Miles of Continuous Pipe

TO make ten miles of pipe into one continuous pipe, making every joint leak-proof and trouble-proof after being buried in ice, was the problem that confronted the builders of the Winter Garden Ice Rink at San Francisco, Cal. Investigation had shown that in many ice rinks where ammonia systems were built with screwed fittings, leaks frequently developed in the joints necessitating shut-downs for repairs, to the financial loss of the management and to the displeasure of patrons.

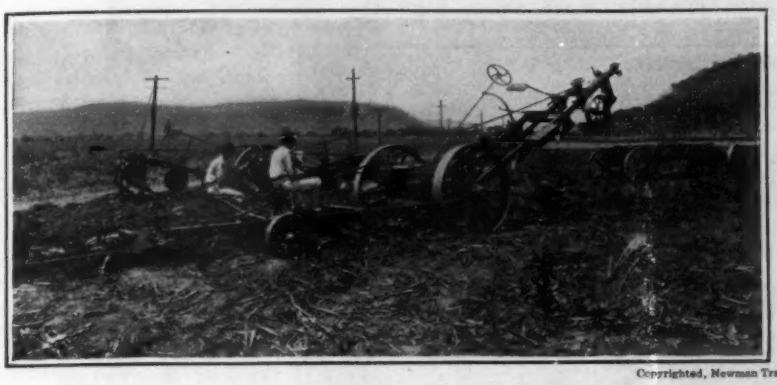
So oxy-acetylene welding of the joints was decided upon in this particular instance, and not only did it make possible a leak-proof system, but a remarkable saving in the purchase price of pipe has been realized. Instead of using new pipe, 55,000 feet of 2-inch used boiler tubing was purchased at a saving of 20 per cent over the cost of new galvanized pipe. Every joint in the system was then welded by an oxy-acetylene torch making use of purified acetylene and compressed oxygen. The floor of the rink, which is shown in the accompanying illustration, is 210 feet long and 90 feet wide, and the welded joints number considerably more than two thousand.

The contractors claim that the work was done by average welders and that the cost per joint was approximately the cost of an ordinary screw connection. One of the welding outfits used appears in the foreground of the illustration.

The rink has been in operation for about six months and the management reports that not a leak has developed in the several thousand joints, which is considered a record among those thoroughly familiar with conventional skating-rink ammonia systems.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



A double-ended plow equipped with dual controls, employed on a Porto Rican sugar plantation

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Another view of the double-ended plow which is drawn back and forth across the field by means of two portable engines

A Plow Which Plows in Either Direction

BECAUSE of the toughness of the stalks and roots from the previous season's planting, the plowing of cane-sugar land requires the heaviest of farm equipment. The conventional horse-drawn plow used by our farmers would have little effect if any on the stumps and roots and soil of a typical cane-sugar plantation.

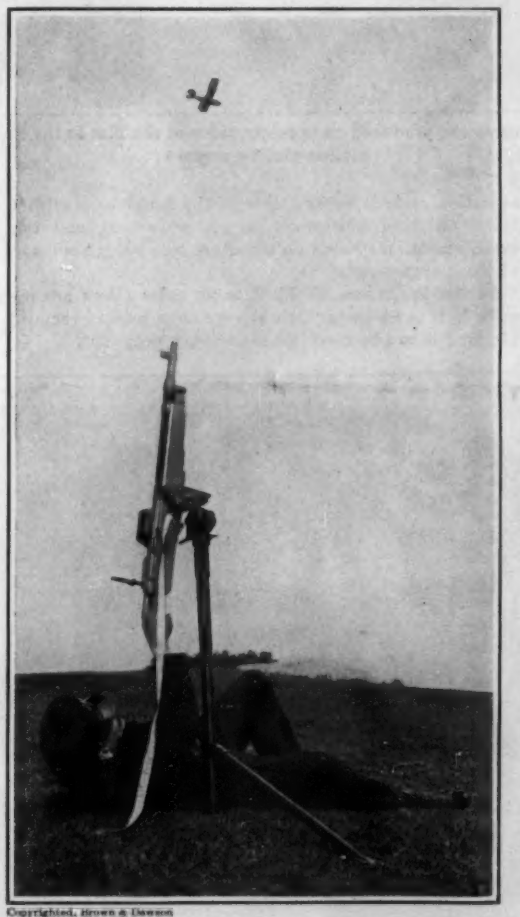
In the two accompanying illustrations there is depicted some of the equipment employed on Porto Rican sugar plantations for preparing the soil for a new planting. The plows used, it will be noted, are doubled-ended machines; that is to say, they can be operated equally well in either direction. The motive power for the plow is furnished by two portable steam engines, one at each end of the field, which pull the plow back and forth by means of wire cables. The V-shaped frame of the plow permits one end to be employed while the other end is held high in the air, clear of the ground. Dual controls enable the operators to use either end with equal ease.

What the Universal Joint Means in the Mounting of a Machine Gun

IN the past machine-gun practice has approved of the use of a heavy tripod equipped with a massive, tilting head operated by a hand-wheel. Not only has this form of tripod proved heavy, but it has not permitted of quick movement which is so essential in playing machine-gun fire on rapidly advancing infantry. Furthermore, this tripod has been seriously affected by vibration in most instances, so that its use on automobiles has been accompanied by no little difficulty in maintaining a steady aim.

Light in weight, free from the effects of vibration and permitting of rapid and free movement of the gun in any direction, a recently-perfected type of machine-gun tripod promises to extend the field of the present weapon. This tripod, which appears in the accompanying illustrations, is provided with a ball-and-socket joint head, permitting the gun to be freely moved in any direction. To lock the gun a lever is given a slight turn, while the gun may be held at any angle in the clamp in which it rests. The new tripod can be readily carried about, and it is an ideal weapon for use in an automobile or motorboat, and as an anti-aircraft piece. In fact, it lends itself to all the customary uses of the machine gun, with many new ones besides.

In the accompanying views the Colt type machine gun is shown applied to the new tripod. This gun is light in weight and uses a belt feed. Each belt holds 250 rounds. The gun is air-cooled, and is provided with extra barrels.



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The recently-perfected tripod and machine-gun used as an anti-aircraft piece

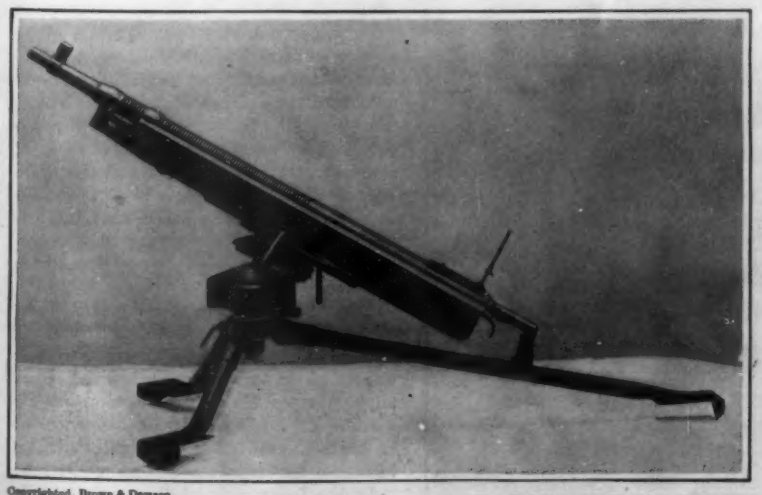
Coal Gas as a Motive Power

OWING to the very limited quantity of gasoline available in England for pleasure car use it has been suggested that coal gas might be used as a substitute, and the matter has been investigated to some extent. The results show that the power developed by gas is about eighty-five per cent of that from gasoline. The gasoline used for the tests in question had a specific gravity of .678, the B. T. U. per pound being 19,500; the engine consumed .65 pound per b. h. p. hour. In the gas there were 485 B. T. U. per cubic foot, and the engine used 24.5 cubic feet per b. h. p. hour. The result of these tests showed that the approximate equivalent of one gallon of gasoline is 250 cubic feet of gas. If the gas is carried in a collapsible balloon bag it is figured that about three hundred cubic feet could be carried on top of a limousine, equivalent to a little over one gallon of gasoline. If compressed in cylinders at 120 atmospheres, or 1,800 pounds per square inch, a cylinder containing 1,000 cubic feet would weigh 1,080 pounds, and this quantity would be equivalent to something less than four gallons of gasoline. Moreover, gas compressed to this degree loses about ten per cent of its thermal efficiency, due to the deposition of some of its constituents. Altogether the plan is not encouraging.

Poison Gas from Plant-Seeds

WHILE carrying on botanical explorations in Venezuela last fall, Dr. J. N. Rose, Associate Curator of Plants in the Smithsonian Museum, secured some interesting specimens of sabadilla, a Venezuelan plant of the lily family, from the seeds of which are produced some of the asphyxiating and tear-producing gases used by the Germans in the war. These highly poisonous seeds have long been used in medicine for the production of cavadine or crystallized veratric, of veratric acid, and of sabadalline, a heart stimulant, but as in so many other cases the German talent seems to have turned them to a less respectable use.

The dust from the seed in the field irritated the eyes, throat and especially the nose to such an extent that the native laborers were obliged to wear masks. It has been reported that the Germans bought up the entire available supply of the seeds before the declaration of war. Both the seed and all preparations compounded from them are now, however, declared contraband.



Copyrighted, Brown & Dawson

Provided with a ball-and-socket joint head, this machine-gun tripod permits of ready control of the fire

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Not affected by vibration, the new machine-gun tripod can be used in the conventional automobile

Using Both Sides of a Film to Produce Motion Pictures in Color

ALTHOUGH motion pictures in natural colors have been on exhibition for a number of years, perfection has not been attained. Every system so far exploited seems to be possessed of certain defects and the subject offers a ripe field for inventors.

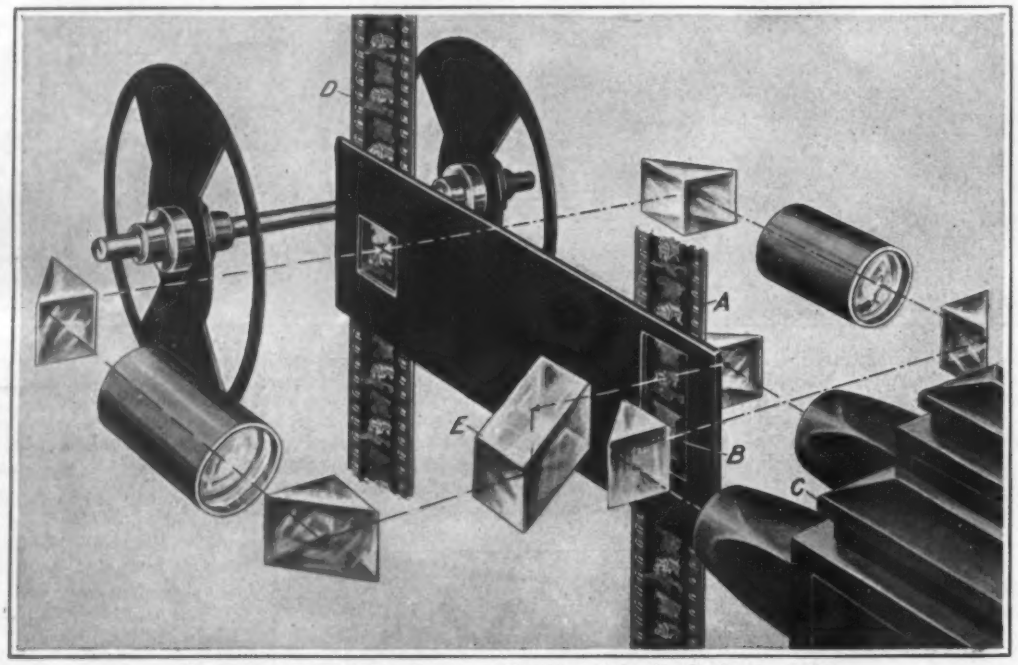
One of the first color processes to meet with a fair degree of commercial success uses a panchromatic film in a motion-picture camera, and the exposures are taken alternately through an orange-red and a blue-green filter. As a consequence, the negative, although a black and white film, has its alternate pictures modified by their exposure to the blue-green and orange-red rays respectively, that pass through the filters. A positive is made from this negative and then the film is run through a projector equipped with red and green filters, the red filter coming into position when the red sensation record or picture is exposed, and the blue-green filter when the blue-green sensations record is exposed. The result is a series of pictures on the screen which are alternately red and green. Persistence of vision combines these pictures so that the eye sees a composite that reproduces the natural colors with considerable fidelity. One of the disadvantages of this system is that the film must be twice as long as the ordinary black and white film and must travel twice as fast as the ordinary film in order to superpose the red and green pictures. It calls for a special type of projector, one fitted with special color filters. Other processes provide for the simultaneous projection of the two records by means of a double projector, or a system of prisms is employed to combine the pictures in a single projector. In some systems instead of having the pictures in pairs, one above the other, which necessitates moving the film through a double frame at each throw of the cam, they are arranged side by side, requiring a film of double the normal width. In either case mechanical, as well as optical, difficulties are encountered.

The latest development very ingeniously overcomes these drawbacks by setting the two pictures of each pair one behind the other, on the same film. In other words, both sides of the film are used, a blue-green sensation picture being recorded on one face and an orange-red on the other. The film itself is dyed orange-red on one side and blue-green on the other.

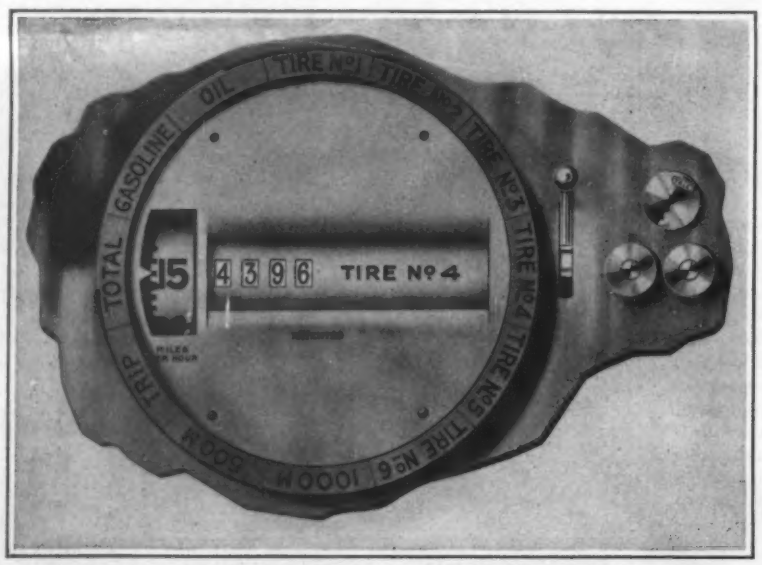
This system has been developed in the research laboratory of a large firm of photographic manufacturers. The method of producing the color film is represented diagrammatically in the accompanying drawing. At "A" is the duplex film in which green sensation records alternate with red sensation records. This is a positive film strip, and may be termed the "master" record. This record is run through a double gate "B" so that a pair of red and green sensation pictures appear in the opening at the same time. Two beams of light are provided coming from the lantern "C." The course of one of these beams of light is indicated by a line of dashes and the other by a dot and dash line. The beam which passes through the lower picture of the pair is carried around by means of prisms to the right-hand side of the sensitized film "D." The beam passing through the upper picture of the pair is brought down to the same plane as that of the other beam by means of a prism "E" and thence it passes through a system of prisms and lenses to the left-hand side of the film "D". This film is coated with a sensitive emulsion on each face and passes through a single gate, moving in the opposite direction from that of the film "A." Its motion also is such that one picture at a time is exposed while the film "A" moves so as to expose a pair at a time. By means of this apparatus the red and green sensation pictures are reproduced on the film "D" on opposite sides of the film and in perfect register one with the other.

Of course the film "D" is a negative and it must be converted into a dye-positive. The film is bleached on both sides at once, and after drying the silver images on both sides are converted into dye images by separately treating them to the respective dye baths; the red sensation records on one side of the double-coated film being all dyed blue-green at one operation, and the green sensation records on the other side being similarly all dyed orange-red.

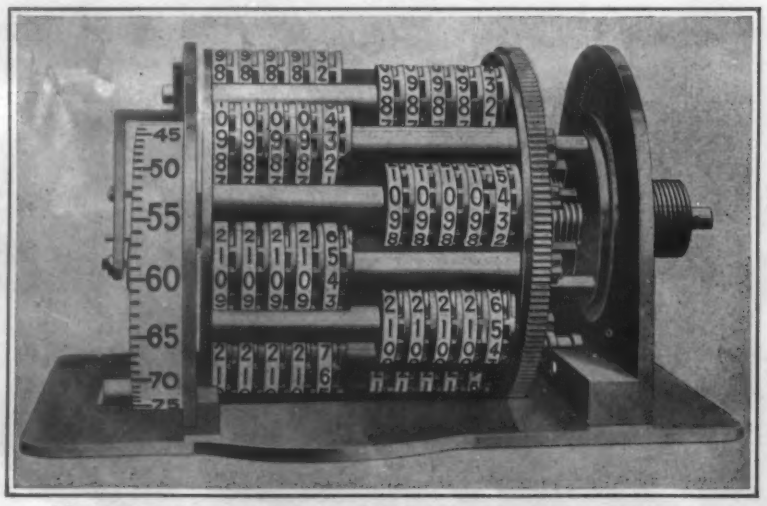
In the projection of this film no color filters are required. It is no longer than the common monochromatic film and it can be used in the ordinary projector.



How pictures are produced on opposite sides of the film in the new color motion-picture process



By turning the milled ring of this meter, the motorist can obtain readings for the various items marked on the rim



Mechanism of the mechanical bookkeeper for the motorist, showing the collection of gears and speedometer driven from a common shaft

A Mechanical Bookkeeper for the Careful Motorist

FOR the careful motorist who is interested in knowing how much service, in terms of miles, he is getting from each of his tires, his gasoline, his lubricating oil and so on, the recently-invented mechanical bookkeeper is certain to prove a boon. The new instrument is not much larger than the ordinary recording speedometer, but there is contained in it, in addition to means for indicating the speed at any given moment and means for recording the mileage of any given trip, as well as the total mileage, means whereby the mileage of each tire is recorded and means for recording the number of gallons of gasoline and oil consumed in the mileage traveled. Furthermore, there are means whereby warnings of the necessary adjustments, such as oiling, cleaning and repairing, required after driving 500 miles, and 1,000 miles, will be recorded on separate recording instrumentalities. In brief, there are contained in the instrument twelve distinct and independently-operating recording devices.

In one of the accompanying illustrations the instrument is shown with the protective cover taken off, so as to show the underlying parts. While the recording devices are each independent of the others, and each performs its functions entirely independently of its neighbors, yet with the exception of the gasoline and oil records which are manually operated, they are all driven from a center shaft which, by intermediate mechanism, drives the recording devices in succession during each revolution of the shaft. The shaft is operated from the wheel or drive shaft of an automobile in the usual manner for operating the ordinary speedometer. In addition to the recording instrumentalities, there is a speed indicator, all of which is combined and enclosed in a very compact instrument. It is protected against unauthorized tampering by a lock.

Six of these recording devices are assigned to the tires carried on a motor car, it being a common practice for the owner to carry two tires in addition to those on the wheels. He assigns to these six tires which are arbitrarily numbered, the recording devices designated Tire No. 1, Tire No. 2, Tire No. 3, and so on. There are means whereby one or more of these recording instrumentalities may be disconnected from the central driving shaft and remain inactive, while the others are performing their functions. If tires numbers 1 to 4 are on the wheels, the recording devices assigned to those tires will be connected for operation. If, for any reason, it is necessary to remove Tire No. 3 for instance, and to substitute therefor temporarily, Tire No. 5, the recording device for Tire No. 3 is disconnected, without disturbing any of the other recording devices and maintaining the recorded total of mileage of Tire No. 3 up to the point at which it was removed. The recording device for Tire No. 5 is now connected to the driving shaft and begins to operate to record the mileage of the tire. If Tire No. 3 should be capable of further use after slight repairs, it may be replaced and the recording device for that tire again connected for operation, while the recording device for Tire No. 5 is disconnected, and the record of mileage for that tire remains recorded, while the recording device remains inactive.

The recording devices for gasoline and oil, as already stated, are operated by hand; the number of gallons of gasoline and quarts of oil turned up each time either supply is purchased. In short, each recording device is a separate one and can be changed without in the slightest degree affecting the adjacent recording devices.

In the front view of the new meter it will be noted that there are two apertures

(Concluded on page 105)

A Place for Everything

(*Concluded from page 99*)

locate storage warehouses without considering military features, railroad facilities, and export facilities. Hence, the men who are attacking these problems are not only military experts but those experienced in railroad and export work, and who have a thorough knowledge of transportation.

It is not enough to have goods manufactured, no matter how well or how cheaply. They must be delivered safely and delivered quickly. Hence, a study of method of packing, of railroad routing, of the part the motor truck and the dray may play in making stored materials swiftly available for export, etc., are important parts of the problem. Similarly, in personnel it is not enough to train the man who will do special work; it is necessary to mobilize from industry the men already trained, and fit them into the particular military establishment where their civilian knowledge of a civilian art will be of the utmost service to their country. A list of storage experts has been made, with special reference to those who can be spared to the Army and Navy without upsetting the industrial world, and already a great deal of storage strain has been lifted from the military arms by the employment and in many cases the commissioning of such men—men found and delivered to the colors by the Storage Committee.

But of all the problems which the Storage Committee has tackled, perhaps none is of greater import or presents more difficult features, than that of the terminals. For here is where the crush is bound to come. It was not very long ago that even the military establishment believed this would be a defensive war—that the Army we raised would fight on this soil or none. Under such circumstances it would obviously have been the part of widsom to have selected storage areas sufficiently remote from the coast to make their capture or destruction, either by armed force or aeroplane bomb, a practical impossibility.

But with the war to be fought—as every one now hopes and believes—on first French and later German soil, a large part of the problem changes from one of immediate supply to one of export. Hence, the terminals will be the places where all the enormous supplies now being developed will eventually find their way. To keep them from being choked to death, to find adequate storage space at terminals, to designate what should wait in areas of assembly and what should go forward at once ready for shipping, to plan train movements handling of material, yes, even to plan what and how and when and where the truck and the dray and the human hand will come into play in caring for these pyramids of supplies—pyramids which would make Ghizeh look like an ant hill—*this* is the problem of the terminals.

Mt. Wilson's 100-Inch Reflector

(*Concluded from page 101*)

the setting circle stand. Auxiliary controls are also placed at the three foci of the instrument. Practically all circuits are "remote controlled," very few being operated by direct switches. All motions are motor driven and all clamps operated by solenoid, circuits being arranged so that the fast and slow motions of either motion cannot be in at the same time. A powerful solenoid draws in the clamp and holds it here either by a small current in itself or by a catch on the lever arm which may be released by a small secondary solenoid.

Altogether there are used in the dome and on the telescope 40 motors of 1/20 to 7½ horse-power in size with an aggregate of 50 horse-power and over thirteen miles of wiring. The current is conveyed to the moving dome by two main trolleys, and for the dome control from the pier by six trolleys, these being placed around the outside of the metal wall of the pier just under the balcony.

Observing Platform

A movable platform is provided for the observer when working at the primary focus. It spans the shutter opening and travels along a track on the face of the main arches in the same way as the crane does, automatically leveling itself for all positions. It is counterweighted driven by a hoist on the balcony. In addition to its motion as a traveler it possesses a vertical motion of seven feet and a horizontal travel of five feet. All motions are controlled by buttons in the hands of the observer. A stairway and balcony permit visitors to view the surrounding scenery, and a room within the dome allows a view of the telescope without access to the instrument itself.

A Mechanical Bookkeeper for the Careful Motorist

(*Concluded from page 104*)

in the face plate or dial, through one of which the speedometer or speed indicator may be read, and through the other of which any one of the recording devices may be viewed, as desired. For instance, in the illustration Tire No. 4 is exposed in the larger opening in the dial. If it be desired to view any of the other recording devices, they are brought into the position which exposes them in the larger opening through the dial. This is accomplished by mounting all the recording devices on a frame which is capable of revolving, and this frame may be revolved at any time without affecting the operative connection of the recording devices with the driving instrumentalities and without disturbing the record of any recording device. The mechanism for revolving the frame is operated by the milled ring which surrounds the dial at the front of the face-plate, which ring bears upon its front face the indicating designations as shown.

The instrument is only a trifle larger than the ordinary speedometer, and is actuated by a single flexible shaft which is equally well connected to the driving shaft of the car or to one of the front wheels.

Digging Trenches by Machinery

(*Concluded from page 102*)

drives the motor truck member—a power plant of 100 horse-power. This is the most popular type of excavator employed by the French troops.

Depending on the natureof the terrain, the trench digger can cut a considerable length of trench in one day. Its crew generally consists of five men and a chauffeur, and it is safe to say that these replace hundreds of soldiers working with pick and shovel. Of course, the trench is by no means completed by the trench digger; but the heaviest part of the work is completed and it only remains for the engineers to finish it with the revetment, proper drainage, boardwalks, sand bags, and so on, all of which is comparatively light work in contrast to that of digging.

As a general thing the trench diggers are kept in parks in back of the lines, together with their crews. They come into action, however, whenever an army moves forward; and thanks to the clever camouflage of paint and foliage the trench digger can safely carry on its work with little danger of being detected by enemy airmen.

Infantile Paralysis in New Zealand

IN the year 1914 New Zealand had its first important epidemic of poliomyelitis. A more severe outbreak in 1916, with 339 cases and 46 deaths, reported in the Wellington Health District, which includes the provinces of Wellington, Taranaki, Hawkes Bay, Marlborough and Nelson, and Cook County. The disease occurred generally along the lines of railway traffic.

Zoological Statuary

AT a recent meeting of the Biological Society of Washington, Dr. R. W. Shufeldt presented some rather startling facts concerning the liberties which sculptors take with natural history in designing monuments and sculptural ornaments. He asserted that a large part of the animal forms seen in public statuary in Washington, as well in other American cities, are untrue to nature, and often highly ridiculous.

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RECENTLY PATENTED INVENTIONS

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Pertaining to Apparel

GAITER.—V. BENEDETTI, Abbott Boulevard, Palisade, N. J. The invention provides a separate gaiter with means for drawing the edge sections thereof into close contact with the shoe; provides a gaiter for supporting the arch of the foot; and provides a gaiter equipped in simulation of a permanently attached shoe top.

Electrical Devices

CHICKEN FOUNTAIN.—C. A. MULLER, 701 Vetas Ave., Pueblo, Colo. In this patent the invention has for its object the provision of a chicken fountain which will feed automatically, and one which will prevent the water contained therein from freezing in zero weather. The walls of the fountain are constructed of non-heat-conducting material.

TAMPER SWITCH.—L. A. GRIMES, 97 Day St., Orange N. J. The main purpose of this invention is to provide electrical means whereby when a normally fixed or closed cover or the like is moved or opened, this fact will be indicated at some distant point as, for example, in the office of the superintendent of the works or some other place, means being provided, however, to stop the sounding of the alarm by any person authorized to initiate the sounding thereof by the opening or moving of the parts. The invention relates to alarm circuits and has been designed particularly as a feature of the automatic alarm for sprinkler systems.

Of Interest to Farmers

COTTON COMPRESS.—W. HILL, Alexandria, La. An objection has existed in the operation of presses in former patents of Mr. Hill in that the material when treated by said presses extends laterally from between the platens of the press, thereby increasing the bulk of the bale and forming margins of material having a density of the body of the bale. His present invention overcomes this objection and provides a compress to prevent the lateral extension or flow of the material under pressure.

POWER-DRIVEN CULTIVATOR.—J. T. HICKMAN, JR., Springport, Ind. The invention relates particularly to a power-driven cultivator which will work in soft fresh plowed ground without packing the ground as if horse-drawn, which will enable the cultivation of two or more rows at a time, accurate steering and in which the power driven parts will act to assist in the cultivator of the ground.

TRAPS.—C. J. LANTIS, Chapman, Kansas. The object of this invention is to provide a trap especially designed for use in trapping gophers, and like burrowing animals, wherein a supporting frame is provided together with a spring operated transfixing member movable with respect to the supporting frame, together with trigger mechanism for normally holding the transfixing member in inoperative position, and adapted to be released by the movement of the animal passing the trap.

Of General Interest

CLIMBING HARNESS.—C. WINTER, Oskaloosa, Iowa. The object here is to provide an arrangement whereby a workman may quickly climb or descend a pole. Another object is to provide an arrangement of harness whereby a workman may move up or down a pole without using his hands.

ENVELOP.—J. G. KNUBCH, 16 Oakland Place, Woodhaven, L. I., N. Y. This invention relates to envelops of that type which can be opened at one end for postal inspection and which are open at the top for facilitating the insertion of mail matter, there being a sealing flap for closing the top after the insertion.

PARTITION WALL—J. B. CAMPBELL, River Front, between First and Brook, Louisville, Ky. This invention relates to a partition wall constructed of thin blocks of plastic material, which are adapted to be used in connection with a

PARTITION WALL

metallic studding strip or reinforcing material which is fastened to the ceiling and floor of a building and to which the slabs are fastened to form a rigid and substantial wall and this strip is preferably a channel iron of any proper cross section.

BOX FASTENER.—J. A. DEINDORFER, JR. 623 Jefferson St., Defiance, Ohio. The inventor provides a fastenor for metal cases more especially designed for containing bottles filled with milk, beer, soft drinks or other liquids, and arranged to provide an exceedingly strong and durable construction to readily withstand rough usage to which cases of this type are subjected while in use.

ACCOUNTING RECORD SHEET.—J. W. PENNEWILL, Silver City, N. Mex. This invention relates to record sheets and particularly to a sheet designed for receiving accounts, as for instance accounts receivable, and for arranging the data in such a manner as to present the accounts of a large number of persons on a single sheet.

PROCESS FOR THE MANUFACTURE OF REINFORCED GLASS.—A. BARDIN, No. 11 bis Rue Jean Nicot, Paris, France. The process consists in covering glass articles for instance, window panes, mirrors, plate glass or other articles, whether plain or not with a reinforcing medium in such a manner as to retain the glass splinters in case of breakage without altering the transparency of the glass by the addition of this reinforcing medium.

CARBON-SHEET HOLDER.—E. B. NORMAN, United Cotton Building, New Orleans, La. The invention has for an object to provide a holder for carbon sheets used for duplicating, triplicating, etc., which can be quickly used and

CARBON-SHEET HOLDER

removed and which can be readily and quickly replaced, and which will be protected against deterioration by exposure. Another object of the holder is to facilitate the adjustment of carbon or transfer sheets for use in connection with an original manifolding pad or the like.

PAPER HOLDER AND CUTTER.—P. VAN B. NEBERGALL, 1109 V St., La Grande, Oregon. The invention provides a holder for reels of wrapping paper or the like, wherein a support is provided for the roll of paper and brake bar normally resting upon the role and having guided movements in the support to and from the roller and carrying a printing roller for printing the paper as it is withdrawn from the roll, a cutting blade for the paper is carried by the support, and adapted to be lifted by the paper when it is moved toward the blade.

Hardware and Tools

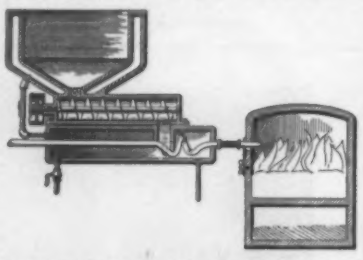
PERMUTATION LOCK.—S. P. HATCHETT and G. L. DILLARD, Mogollon, New Mexico. The invention relates to an improvement in permutation locks used with electric switches. One of the objects is to provide a lock whereby the operation of the switch can only be accomplished by authorized persons. Another object is the provision of means for preventing access to the interior of the casing by securing sections thereof, together through the medium of a locking device.

REFRACTOMETER.—G. W. MOFFITT, care of Washington University, Department of Physics, St. Louis, Mo. An object of this invention is to provide a simple, sensitive and easily operable instrument for direct reading of the indices of refraction of liquids; a further object is to provide an optical system in which one of the optical elements is a liquid, the refraction of which is to be determined, and which liquid can be easily and quickly placed in or removed from the optical system.

LAWN MOWER.—W. HILL, Alexandria, La. The principal objects which this invention has in view are: To provide mechanism for cutting grass in advance of the supporting structure of the cutter; to prevent the matting of grass; to provide means for regulating the height at which the cutting is effected; and to provide a simplified and inexpensive cutting mechanism.

Heating and Lighting

APPARATUS FOR FEEDING POWDERED OR PULVERIZED FUEL.—F. CALDWELL, 7510 Cornelia Ave., Carthage, Cincinnati, Ohio. This invention relates particularly to apparatus for feeding powdered or pulverized fuel by use



APPARATUS FOR FEEDING POWDERED OR PULVERIZED FUEL

of an air jet, the air co-mingling with the fuel in its passage to the point of consumption. An object is also to provide a simple apparatus in which provision is made for heating of the fuel and the air, and the mixture thereof, to avoid chilling the gasses within the furnace.

COMBINED STOVE AND ARTICLE-SUPPORT—D. DAVIS, 413 Broadway, New York, N. Y. The invention relates to a combination heating device and means for holding articles thereover, and has for one object the provision of an arrangement designed to be mounted upon a burner in such manner that the burner may be applied and removed when ever desired. Another object is to provide a stove using kerosene in connection with a support having a guard rail for holding articles in place on the support

Household Utilities

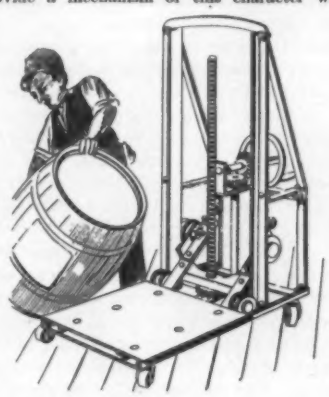
FLY POISONER.—E. J. BELBAL, 205 W. 5th St., Valley City, N. D. The invention relates to means for killing insects, especially flies, and provides a poison holding tank and means for automatically maintaining the same at a desired level arranged within a container positively preventing access thereto, as by children or pets, which container is also provided with means for attracting the flies to the container.

COMBINATION ARTICLE OF FURNITURE.—D. A. SELIGMAN, 2921 Kensington Ave., Kansas City, Mo. The invention is an article of furniture forming as a whole a substantial Morris chair of conventional appearance, the various elements entering into the structure separately constitute additional articles of furniture whereby the unitary structure provides in convenient form, a chair, a chiffonnier, a bookcase, or desk, a writing table and a shaving cabinet.

SHADE-ROLLER.—A. J. SOUDERS, 99 Liberty Place, Weehawken, N. J. The object of the inventor of this window shade roller is to provide an improved arrangement for normally locking a roller against movement and allowing a movement of the roller in either direction when given a sudden pull or jerk; a further object is to provide a hook or catch for a shade roller which utilizes one or more balls and a guide connected with the roller.

Machines and Mechanical Devices

ELEVATING TRUCK.—J. H. ANDERSON, Havana, N. D. The invention relates generally to elevating trucks, or portable elevators, and particularly to mechanism of this type employing constructional features, the object being to provide a mechanism of this character which



ELEVATING TRUCK

will be strong and durable, highly effective for the purpose intended, at the same time simple and inexpensive and well adapted to the portage and elevation of heavy articles and goods in the several uses to which mechanism of this character may be conveniently put.

AUTOMATIC EXPOSURE-SPACING MACHINE FOR ROLL-FILMS FOR CAMERAS.—E. G. ERVIN and F. C. SMITH, Stilwell, Oklahoma. The invention relates generally to cameras, and particularly to film winding mechanism in connection therewith to automatically wind the film in advancing unexposed sections for exposure manually controlled to operate after each exposure for this purpose, the object is to provide a simple arrangement which may be readily utilized in connection with cameras now in use, or which may be constructed in connection with a camera to form part thereof.

FOLDER FOR SEWING MACHINES.—H. RUBIN, 102 Delancey St., New York, N. Y. The object of this invention is to provide an adjustable folder whereby the same can be used for various widths of bindings The guide sections are so arranged as to fold the strip passing therethrough twice, consequently presenting a clean edge to the fabric to be bound.

TRANSMISSION MECHANISM.—R. C. HILL, Box 1017, Memphis, Tenn. The object here is to provide mechanism especially adapted for use in marine work, and for vessels operating in shallow water, wherein a greater propelling area may be safely and efficiently operated with a minimum of power and without loss of power.

APPARATUS FOR LAUNCHING REVETMENT MATS.—D. MCD. SHEARER, Vicksburg, Miss. The inventor provides a mat barge having a plurality of inclined ways consisting of a series of rollers adapted to support a mat and guide the same, the delivery end of said ways terminating in a downwardly curved launching frame, from which the mat passes into the water. But it is to be understood that Conveyer chains, cables, or belts may be substituted for or used in connection with said rollers as circumstances may warrant one to facilitate launching of the mat from the ways.

MEASURING APPARATUS.—D. W. UBER, Sheffield, Pa. Mr. Uber's invention is an improvement in measuring apparatus and provides a mechanism by means of which the depth of a well may be ascertained without the use of a measuring line, by measuring the rope or cable of the well.

Medical Devices

FACING FOR A JACKET-CROWN.—I. BROWN, 1288 Southern Boulevard, Bronx, N. Y. An object of the invention is to provide a facing to which the metal jacket can be easily and quickly secured by any one versed in the technique of dentistry. A further object is to provide a facing for the jacket crown which will be strong, which has means for engaging the metal which is to form the socket so that the same is firmly anchored into the body of the facing.

HIGH-FREQUENCY THERAPEUTICAL APPARATUS.—W. KLEINBERG, 50 Church St. New York, N. Y. The general object of the invention is to improve the construction of circuit make and break devices for high frequency induction coils and all other devices where an oscillatory, a make and break, or any movable contact is employed; so as to be reliable, generative of more power capable of ready adjustment for varying the strength of the generated current, without causing any increased sparking at the contacts.

Musical Devices

AUTOMATIC EXPRESSION CONTROL FOR PIANO PLAYERS.—M. S. HOWARD, Waukon, Iowa. This invention regulates the degree of vacuum attained in the striking pneumatics, through the action of a valve controlling the passage between the striking pneumatics and the exhaust chamber, and operated by a valve control pneumatic whose action is regulated by air pressure whose varying degrees are attained through the coaction of auxiliary openings in the tracker bar, and openings in the music sheet, whereby maximum efficiency in the reproduction of the accent touch and expression employed by a musician in rendering a composition, may be attained.

ELECTRICAL PIANO ATTACHMENT.—D. P. MUSE, Junction City, Ark. In accomplishing the object of this invention use is made of a piano having the usual keys and sounding devices controlled by the keys and actuating devices connecting the said piano keys with the sounding devices of the other musical instruments to sound the latter in harmony with the piano on playing the keys thereof.

FILING-CABINET FOR DISK RECORDS.—A. C. BOLTON, 260 Clinton Ave., Brooklyn, N. Y. An object of the invention is to provide a cabinet in which records of various sizes can be filed simultaneously and which records are easily accessible independent of their size. A further object is to provide a cabinet in which any record in the cabinet may be exposed without exposing the other records in the cabinet.

MUSIC-SHEET TURNER.—C. W. SMITH and E. A. O'BRIEN, 521 West 156th St., New York, N. Y. Among the principal objects which the invention has in view are to provide means automatic in character for turning a sheet of music, to provide a folder for carrying sheet music, which may be used as a rack for holding sheet music in service.

Prime Movers and Their Accessories

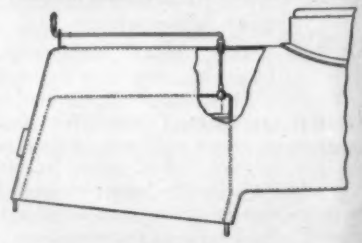
AUTOMATIC ADVANCING GEAR.—J. E. CROWELL, care of Matthews, Mekienburg Co., Union County, N. C. The invention relates more particularly to cam shaft gears and an object is to provide a gear for the cam shaft of an internal combustion engine whereby the valves may be prematurely opened when the engine speeds up, in order to derive the full benefit of the power of the engine.

ATTACHMENT FOR INTERNAL COMBUSTION ENGINES.—R. L. JENKINS, 725A West Cary St., Richmond, Va. This improvement provides a device by means of which additional air may be mixed with the charge coming from the carbureter so as to dilute the explosive mixture when desired, thereby saving in gasoline. It provides a device which may be used as an auxiliary carbureter for supplying an explosive mixture.

WATER TUBE BOILER.—H. A. TURNBULL, 50 Newton St., Surrey Hills, Victoria, Australia. This invention secures greater efficiency in the production and maintenance of a steam supply for marine and other engines, and for all other purposes, and provides a set of steam generating "elements" which shall be separately removable and interchangeable and at the same time adapted to produce the most rapid circulation and a high pressure of steam with economy of fuel.

ROTARY ENGINE.—C. W. BROWN and W. A. BROWN, Mass, Michigan. This invention may be embodied in a rotary combustion engine or in a steam or other fluid-driven engine, or in a rotary pump, it being understood the term engine includes a pump. The engine is characterized by a rotor having movable vanes or pistons and a stator having an annular working cylinder in which the vanes operate and which is divided at the center by the rotor into two side chambers.

LOW-WATER ALARM.—H. B. THURSTON, 901 Standard Life Bldg., Pittsburgh, Pa. The invention relates generally to low-water alarms and more particularly to that type of device which is secured in the crown sheet of a boiler and includes a fusible element normally controlling



LOW-WATER ALARM

the egress of steam, the device so constituted being connected to a posterior alarm signal so that upon the fusing of the fusible member the escape of steam will sound the alarm; other objects are for the fusible members protection, and its ready removal for cleaning purpses.

POWER-CHAMBER.—J. F. SCOTT, 407 West 23d St., New York, N. Y. The invention relates to power members and particularly to a chamber especially designed for use in explosive engines. It has for an object the provision of an improved construction wherein any desired compression may be secured in order to produce a maximum result or maximum return for the fuel used. A further object is to provide a power chamber in which an expanding bellows construction is used.

Railways and Their Accessories

ABSOLUTE AND PERMISSIVE BLOCK SIGNALING.—J. SHOECRAFT, Eskridge, Kan. This block signal system is especially useful on single track railways provided with sidings and

(Concluded on page 108)

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The Submarine Problem—XI.

(Concluded from page 97)

shown in that article, by hinging the plates vertically at their forward end within rectangular steel frames, supported from floats or from the side of the ship. In the present article we give illustrations of an ingenious method of securing the same result, which has been designed by Mr. S. Davis Robins. Each plate is suspended at its top edge to a bar which is supported from the side of the ship, and is held in an inclined position, the forward end of the bar towards the bow of the ship being several feet lower than its after end. The upper edge of each plate is cut to conform to the slope or pitch of the bar to which it is hinged. This arrangement secures the result that, as the plate swings laterally upon its downwardly inclined axis, the center of area of the plate is necessarily moved slightly forward, the degree of this movement depending upon the steepness of inclination of the supporting rod upon which the plate swings. Hence it follows that any departure of the plate from its normal vertical position is characterized by an increase in the resistance or drag in the water, and the plate is thus automatically carried back to the vertical position and is thus effectively stabilized.

It will be clear that, the instant the plate begins to swing out of the vertical position, it encounters a reaction of the water tending to thrust it back to the vertical, this reaction being greater the greater the swing of the plate away from the vertical. Hence the action of gravity and the motion of the vessel hold the plate in a vertical position of stable equilibrium, since this is the position in which the plate is subjected to the minimum of resistance by the water.

The plates are suspended from hinged outriggers, which are guyed back from their outer ends to the rail of the ship, where the guy ropes are led to a series of drums on a length of shafting running fore and aft. Should the sea become so violent as to threaten to wreck the system of plates, it can be drawn up clear of the water and made fast to the sides of the ship.

Starving a Fire by Means of a Blockade of Steam

THAT the answer to a perplexing engineering problem is often a ridiculously easy one—after it has been found—involving merely the application of some perfectly well-known principle, has seldom been better demonstrated than in the case of a huge Louisiana gas well fire of a couple of months since. The well in question, which had been flowing at the rate of forty-four million cubic feet per day with a head pressure of fifteen hundred pounds to the square inch, caught fire from an explosion in the well-house. While the velocity and pressure of the gas stream were sufficient to hold the flames at a height of 100 feet from the ground, they spread at that altitude over an area of several acres and were accompanied by a deafening roar and a heat so intense as to hamper the efforts of the would-be extinguishers below.

After futile efforts to cap the well, it was proposed to dynamite it with the idea of creating such a blast of air as would blow the head of flame off the stream of gas; but before doing this, it was decided to give a New York expert a chance to put out the conflagration by less desperate and destructive means. But when the latter arrived five days after the outbreak and proceeded with his preparations in a way that made it plain that he proposed to extinguish the fire by means of a jet of water from a hose, he was jeered loudly and informed that there wasn't enough water in the state of Louisiana to put out that fire. From their own point of view, indeed, his volunteer informants were entirely correct; smothering the fire with water in the usual manner of the city fire departments would have been a ridiculous undertaking. But the expert had no such scheme in mind.

What he did was simply to bring up two hose lines of moderate size and play them from opposite sides so that their streams met in the non-burning stem of gas issuing from the well. They were then slowly elevated until they reached the base of the flames, where they were held. Within five minutes the cushion of steam formed was sufficiently heavy to cut off the gas supply from below—and the fire was out.

While the general principle employed in this stunt is familiar to every high school student through the well known experiment of holding a wire gauze over a Bunsen burner, lighting the gas above the screen, and observing how the flame will not communicate to the gas below this very flimsy barrier, its application to the gas well peril is a distinct departure, and one which takes much of the menace out of these conflagrations.

A New Permanent Magnet Steel

A NEW steel of considerable importance has been made in the United States for the last year or so, directly the outcome of war conditions. It is a new permanent magnet steel, a substitute for the older steel, known as tungsten magnet steel, used exclusively for this purpose before the war. If it had been made in Germany since the war started it would probably have been exploited as a wonderful substitute alloy.

Not long after the war began and the price of tungsten advanced, efforts were made to find a steel that would be cheaper and also as efficient as the permanent magnet steel then being used, containing anywhere from five to ten per cent tungsten and sometimes even up to 25 per cent. The demand was insistent from both magneto makers and electric companies making electric meters, because the tungsten magnet steel was reaching prohibitive prices. It was even stated that automobile makers were substituting batteries instead of magnetos because American steel makers could not make as good magnet steel as foreigners—manifestly an incorrect statement.

The new steel, which is reported to be not less than 90 per cent as efficient as the old permanent magnet steel, is a 0.90 per cent carbon steel containing about two per cent of chromium and is now being made in electric furnaces in this country and extensively used by many consumers.

This new type of steel is based on investigations made by Dr. John A. Mathews of Syracuse, N. Y., and published by the American Society for Testing Materials about three years ago, in which it was pointed out for the first time that certain types of steels are better magnetically when quenched in oil than when quenched in water. This statement was entirely contrary to all previous ideas regarding the hardening of steel for permanent magnets.

Magnetically this new chromium steel is equal to tungsten magnet steel in permanence and somewhat lower in residual density. Users have found it possible to substitute this steel for the older steel without making any change whatever in their windings or in the cross sections of the magnets used.

Practically chrome magnet steel, as the new steel is called, is not as good as the tungsten magnet steel because it requires oil hardening which is not as convenient as water hardening and also because chrome steel in its natural state is much harder to drill or machine and the steel itself must be handled with greater care and uniformity in heat treatment than is necessary with tungsten steel.

A large electric manufacturing company in this country has this to say regarding the new steel:

"We have been using this material for permanent magnets for some time past. By close co5peration with the manufacturers of the steel and careful development of the necessary method and processes for its treatment, we have been able to obtain results which are entirely satisfactory."

Jewelers Will Conserve Platinum

IN view of the great need of platinum for scientific, educational and industrial purposes, especially under war conditions, the Jewelers' Vigilance Committee, in response to suggestions from the Department of Commerce, has adopted a series of resolutions urging the jewelry trade to reduce to a minimum the amount of this metal used in jewelry.

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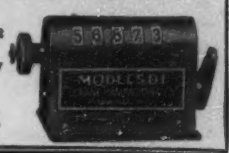

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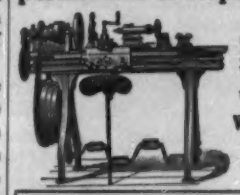

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FOREIGN COMMERCIAL NOTES AND QUERIES

The SCIENTIFIC AMERICAN has always enjoyed a wide international circulation. Its voice is heard in the remotest corners of the earth. Now that American manufacturers have been stirred to the advantages of international expansion we are anxious to do our part in bringing American products into foreign markets. Hence this department has been established to pave the way for American trade expansion to all quarters of the globe.

Those who are interested in the trade opportunities listed in this column, can obtain the names and addresses by complying with the following simple rules: 1. Write only one inquiry on a sheet. 2. Always give the serial number. 3. Write on your own business letterhead. The SCIENTIFIC AMERICAN assumes no responsibility for the financial standing of concerns or individuals. Address all communications to the Query Editor of the SCIENTIFIC AMERICAN, Woolworth Building, New York.

608.—A correspondent in Arnhem, Holland, would like to secure agency for gas and petroleum motors, electric motors, bakery machinery and automobiles.

609. An agency is desired by a man in France for copper, zinc, steel, font, lead, tiles, etc.; hardware and small tools; and library paste. Correspondence should be in French. References.

610.—A man in Guadeloupe desires to be placed in communication with manufacturers of chemical products and drugs. Correspondence should be in French.

611.—A man in Chile desires to establish business relations with exporters of bicycles, automobiles and accessories, typewriters, computing machines, etc. Payment will be made by 60 days' sight draft. Reference.

612.—A man in Italy wishes to secure an agency and to purchase gasoline and oil-burning engines and motors; marine engines, etc., for fishing boats, launches, and motor boats from 1 to 100 horse-power; all accessories for such engines; machines and tools for machine shops; all technical articles and accessories used in motor boats and aviation; varnishes that will not corrode; steel wire; files; rasps; vises, including the complicated combination platform vises in sizes up to 365 millimeters; monkey wrenches; screw drivers; pliers; pincers; wire cutters, and combination tools for naval furnishing. Quotations should be f. o. b. New York. In normal times the terms of payment are 30 days with discount of 2 per cent, or 3 months without discount. At present one-half paid with order and the other half against documents at American port. Correspondence may be in English. References.

613.—A retail merchant in France desires to purchase cigar and cigarette lighters, chiefly the stones called "ferrocyanum" for the lighters. Catalogues should be submitted. Quotations should be f. o. b. New York. Payment, cash against documents. Correspondence should be French. Reference.

614.—The wholesale purchase or an agency is desired by a man in France for acetones, acetic acid, and acetate of cellulose. He can make purchases of large quantities each year and will give guaranty in advance. Correspondence should be in French. References.

615.—A man in Venezuela desires an agency for patent medicines, electrical appliances, oil-extracting machinery, steam and gasoline engines, and motor car and launches. Correspondence may be in English. Reference.

616.—An agency is desired by a man in Italy for common, round, flat and T-V-Z iron; poutrelles, commercial sizes; steel, first and second qualities, round, flat, hexagonal, in commercial sizes; zinc, in slabs and pigs, of different commercial sizes. Correspondence may be in English. References.

617.—A man in France desires to purchase for his own use one set of machines for corn flour manufacture. If he finds machines satisfactory, will make larger purchases. Quotations should be f. o. b. New York. Cash will be paid against documents. Correspondence may be in English. References.

618.—The agency or purchase of fine and heavy chemicals is desired by a man in Italy. Terms of payment to be by open credit. Correspondence may be in English. References.

619.—A man in France desires to purchase and to secure an agency from manufacturers of "papier bitume," waterproof roofing paper for the construction of temporary frame buildings. Catalogues, samples, and price lists are requested. Correspondence may be in English. Reference.

620.—A firm in France desires to purchase irons, round and square. Irons for borers, corrugated irons, sheet steel, white iron, shovels, picks, wire gauzes, mudon glass, cement, lime and lumber. Correspondence should be in French. Reference.

621 —A man in Italy desires an agency for motor cars, motorcycles, and motor tricycles and accessories. Correspondence may be in English. References.

622.—An agency is desired by a man in the Netherlands for advertising blotters, calendars, show cards, pictures, etc.; ash trays, clocks, letter openers, and similar articles which may be used for advertising purposes. Correspondence may be in English. References.

623.—A merchant in Italy desires to purchase a good quality of pocket knives, razors, scissors, shears, and notions. Cash will be paid. Correspondence may be in French or Italian.

624.—A wholesale dealer in France desires to purchase laminated shining steel in bands for fabrication of saws. Quotations should be f. o. b. New York. Cash will be paid against documents. Correspondence should be in French. Reference.

625.—A mercantile and manufacturing company in Italy desires to purchase leather cigarette and cigar cases, leather and imitation leather valises, umbrella ribs (packed in cases of 2 dozen to 6 dozen), metallic parts and fittings of umbrellas and parasols, toilet articles and accessories, especially novelties, purses and pocketbooks in leather and art leather (stamped, tooled, and novelty). Manufacturers are requested to forward latest catalogues. Payment should be made in 30 days after receipt of the goods. Correspondence should be in French or Italian. References.

626.—A man in Bolivia who has been very successful as a general importer and exporter, wishes to secure agencies for sheet steel, corrugated and flat, galvanized etc., wire nails, steel rails and structural steel, window and plate glass, flour, lumber, canned salmon and other canned foods, Siam and India rice, cement, paints and oils, and explosives. He prefers to deal direct with manufacturers.

RECENTLY PATENTED INVENTIONS

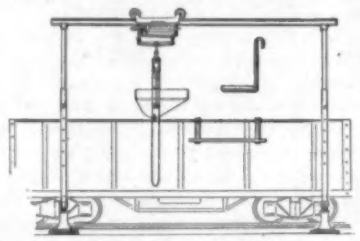
(Concluded from page 106)

whereby a train traversing the track way and approaching the siding may cause a danger signal to be displayed at the siding when an opposing train enters the vicinity of the siding, thereby holding the opposing train beyond the siding so that the approaching train may enter the siding, and whereby opposing trains approaching each other on the trackway will be given absolute stop signals, while following trains will be given permissive signals so that the rear train may follow the leading train from block to block.

SELF-CENTERING RAILWAY TRUCK.—N. PYNN, 422 13th St., Brooklyn, N. Y. In this case the invention has reference to railway trucks the axles of which are adapted to become radial to the curvature of the track and thereby diminish the resistance to motion and reduce wear on the track and wheels and other truck parts.

AUTOMATIC BLOCK SIGNAL APPARATUS.—V. W. BAUMGARTNER, 2321 Humbolt Ave., Oakland, Cal. This invention relates to automatic block signal systems especially adapted, although not necessarily limited, to single track traffic, the system contemplating the use of green, yellow and red signal lamps at the ends of each block, whereby the traffic conditions can be reliably governed by prearranged signals.

COAL-UNLOADING DEVICE.—J. H. TUTWILER, 310 Peters Bldg., Atlanta, Ga. The device has for its object to provide mechanism comprising end frames adapted to be connected with a coal car and adjustable to various sizes of cars, the frames carrying a rail upon which a

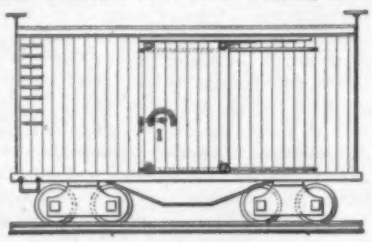


COAL-UNLOADING DEVICE

carriage is mounted to travel from end to end of the rail and the frame, the said carriage carrying a bucket for receiving the coal, and a scale for weighing the bucket and the coal the bucket being connected to the scale by hoisting mechanism to permit the bucket being raised or lowered.

SWITCH.—J. E. BRADRICK, West Unity, Ohio. This switch operating mechanism is for use in connection with switches of any character, wherein mechanism is provided in connection with the switch points operable at a distance from the points for moving the points from open to closed position and for locking them in closed position; it is adapted to be mounted on the cab of an engine, permitting the engineer to operate said switch, from the engine without the necessity of stopping the train.

CAR-DOOR LOCK.—P. YONOS, Canton, Ohio. The invention has for its object to provide a device especially adapted for locking the doors of railroad cars, wherein a locking bar or

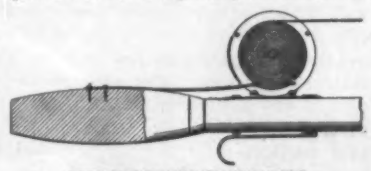


CAR-DOOR LOCK

bolt is provided pivoted at one end of the door, and adapted to engage at the other a hasp or staple on the door, the bar or bolt having a lost motion connection with the door, and wherein a guide is provided for the bolt.

Pertaining to Recreation

REEL BRAKE FOR FISHING RODS.—R. B. KING, Address George E. Hoffman, Attorney, Pensacola, Fla. One of the principal objects of the invention is the provision of an improved means for regulating the tension on a



REEL BRAKE FOR FISHING RODS

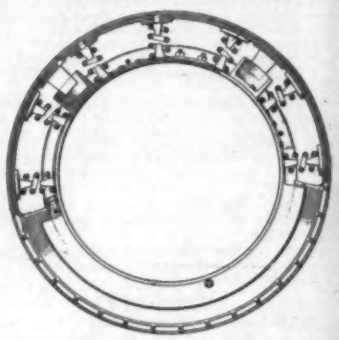
fishing rod reel, so that the fisherman will not have to use his thumb in controlling the reel, and whereby the "back lash" ordinarily occurring when casting, if the reel is under no control, will be eliminated.

METHOD OF COLORING MOVING PICTURE FILMS.—C. W. MABLE, care of Ford Motor Co., Photo. Dept., Detroit, Mich. Among the principal objects of invention are: To provide moving picture films with uniform color tints evenly applied; to blend the tones of the material employed in coloring the films and to reduce the time and labor required for coloring films.

Pertaining to Vehicles

RADIATOR FOR AUTOMOBILES.—I. SILVER, 290 E. 9th St., New York, N. Y. The improvement refers particularly to a construction especially adapted for use on automobiles and other places where water or other cooling medium is to be quickly cooled, and provides a construction which provides for a minimum number of places where the parts are to be connected together. It provides a radiator in which the soldering of joints has been eliminated by reason of the construction and arrangement of water carrying members.

SPRING-TIRE.—C. F. CRAIG and W. FREEMAN care of Dr. Wm. Freeman, Pottsboro, Texas. The invention has for its object to provide a spring tire adapted to use with vehicles of any character wherein the tire is composed of metal rim and tread members movable radially with



SPRING-TIRE

respect to each other and having cushioning mechanism interposed between the same, having also means for limiting the angular movement of the tread and rim members with respect to each other.

RESILIENT TIRE.—S. SUSS, 1391 2d Ave., New York, N. Y. This invention has particular reference to a tire construction designed primarily for the purpose of taking the place of the usual and troublesome inflatable inner tube. It provides a form of filler or padding substantially filling the space between the cushion and the inner wall of the shoe.

TAIL LIGHT.—A. W. MORFORD, New Monmouth, N. J. Mr. Morford's invention pertains to a tail light embodying two independent light sources controllable from the seat of the driver of a vehicle. He provides a tail light which carries an auxiliary searching light adapted to be rendered operative independently of the tail light when backing the vehicle.

WHEEL.—G. P. B. HOYT, 1 Clinton Place, Jamaica, L. I., N. Y. This inventor provides a wheel of the detachable rim type, and arranged to permit convenient placing the rim in position on the wheel, to securely lock it in place thereon, and to allow of quickly removing the rim from the wheel for repairs or for replacement by another whenever it is desired to do so.

AUTOMOBILE TIRE.—J. C. SMITH, Mobile, Ala. One of the principal objects of the invention is to provide a tire for automobiles and similar vehicles, in which a rigid casing is utilized in holding a pneumatic tube which acts as a cushioning device for radially movable tread segments supported by the casing and adapted to transmit the road shocks to the pneumatic tube. Another object is to provide a casing, on the tread portion of which are a plurality of tread segments in the nature of studs.

POST-DRIVER. H. C. UPCHURCH and TH. HOUSTON, care of R. H. Harrison, Steelville, Mo. The invention is an improvement in pile drivers, the object being to facilitate the erection of the posts in a vertical position when a fence is being constructed on a hillside or other uneven ground, to this end there is provided a portable platform, bearing standards which are adjustable so that when such platform is in other than a horizontal position said standards may be adjusted to a vertial position.

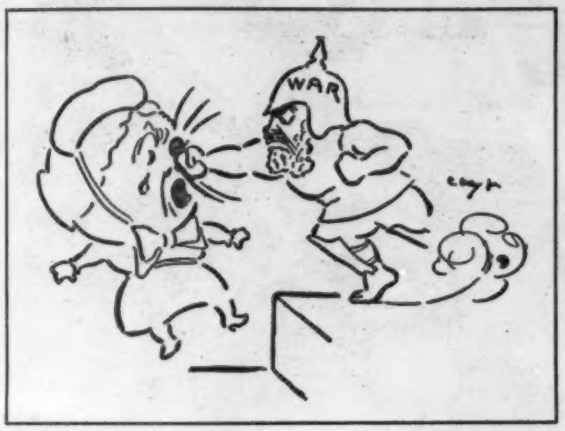
CIRCUIT COMPLETING PLUG FOR LAMP SOCKETS.—J. L. CAMPBELL, 513 N. Butler St., Lansing, Mich. The invention relates to an attachment for lamp sockets of lighting system in which lamps are in series, whereby the burnt-out or broken lamp can be removed and the attachment plugged into the emply socket so as to complete the circuit and thus take the place of the lamp; it is especially adapted for electric lighting systems on automobiles wherein the lamps are in series.

SPLASH SYSTEM OF LUBRICATION.—F. A. SMITH, 6 Washington Place, East Orange, N. J. An object of this invention is to provide a simple and inexpensive contrivance in which there are no movable parts and which can be easily and quickly attached to a splash-lubricant system at comparatively little expense and with substantially no alteration in the splash system. An object is to provide an oil indicator and distributer particularly adaptable for the Ford cars.

Designs

DESIGN FOR A LENS.—A. and C. MATISSE, 551 E. 116th St., New York, N. Y. The lens in this design is in the shape of a disk which has a plane surface and a corrugated surface formed of a plurality of concave grooves having the curvature of a cylinder and of substantially the same width and running parallelly the adjacent grooves joining in a sharp edge. The ends of the grooves are shallowed to retain maximum strength at the margin of the disk.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the invention, and date of this paper.



The End OF THE World?

NO. It's not. She is being pretty cruelly battered, but she will survive. This madness, this thing we call War, that attacks her at times, has terrible powers, but it hasn't the power to last.

While it's here, there are some compensations. We are stirred to our depths, we are all more alive, more sincere. There was never such a time for true friendships, and for all that's most real.

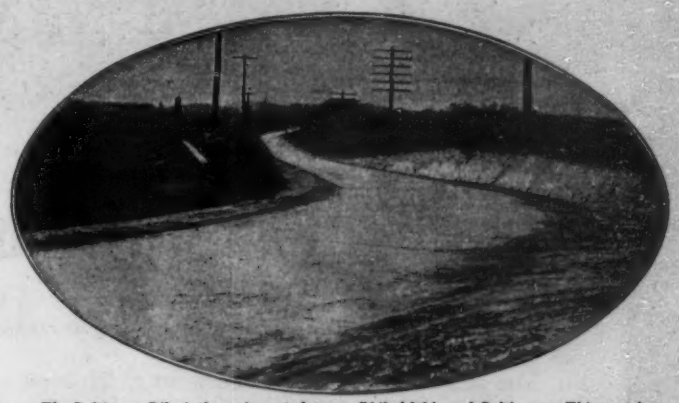
The Metropolitan Magazine is fighting its part in this war. Read its searching editorials that keep just ahead of the times, its news of conditions abroad by the keen William Hard, its articles by Roosevelt that ring out across the whole land, its spirited, truth-dealing fiction, its words of the future, —that new and more vigorous age that is already dawning.

It's the kind of a magazine American homes need in war-time.

In the September Metropolitan—Just Out

Snakebite (a complete novelette) by ROBERT HICHENS	My Conversion to Spiritualism by SIR ARTHUR CONAN DOYLE
An Editorial Message by THEODORE ROOSEVELT	I've Come to Stay (3 part serial) by MARY HEATON VORSE
Adventures and Letters of RICHARD HARDING DAVIS	The Perils of Writing for the Movies by W. J. ABBOTT

At All Good Newsstands—August 8th



The Baltimore Pike is the main route between Philadelphia and Baltimore. This stretch of concrete on it in East Nottingham Township, Pa., is over 4 miles long. It was built by the State Highway Department; Wm. D. Uhler, Chief Engineer, Harrisburg, Pa.

Let Us Stop Waste of Road Funds

Less than 1 per cent of our highways are permanently improved. The other 99 per cent is being ground to pieces by a kind and volume of traffic for which they were never intended—millions of motor cars in active service. Minor repairs have developed into frequent renewals. The cost absorbs the great bulk of all the road funds available.

There is one way to stop this waste. That is to build systems of permanent roads. Financing a system of concrete highways requires more money than is generally available from current funds. As a result, bonds are necessary. Railroads and other large enterprises long ago discovered the value of bonds in making improvements too extensive to be paid for from current income; but it has taken the people a long time to realize that a road system, built with a bond issue, saves more than enough money to pay such bonds and the interest upon them.

Bond Issues for Concrete Roads Do Not Increase Taxes; They Reduce Them

Interest and sinking fund payments are soon more than offset by the saving in upkeep. After the bonds have been retired, the roads are still a good investment, free of debt.

Snohomish County, Washington, in 1916 completed the first 42 miles of a 140-mile concrete road system. The County Engineer, W. C. Bickford, reported to his Board of County Commissioners, as follows:

> "In 1916 the county road and bridge levy was decreased by one mill, and the road district levies cut down from 10 to 6 mills. The general county tax imposed at the same time to take care of the sinking fund and interest on the roads was 2.7 mills. Thus the net result in the matter of taxes entailed by the issuance of road bonds for the first year after their issue has been a net increase of only 1.7 mills on the incorporated cities, and a net reduction of 1⅓ mills on the road districts, which comprise all property outside of the incorporated cities."

CONCRETE ROADS:
THEIR ADVANTAGES

No Mud—No Dust
No Ruts—No Holes
No Slipping
No Skidding
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Smooth Riding
Long Life—Safety
Always Ready for Use
Low Maintenance
Moderate Cost

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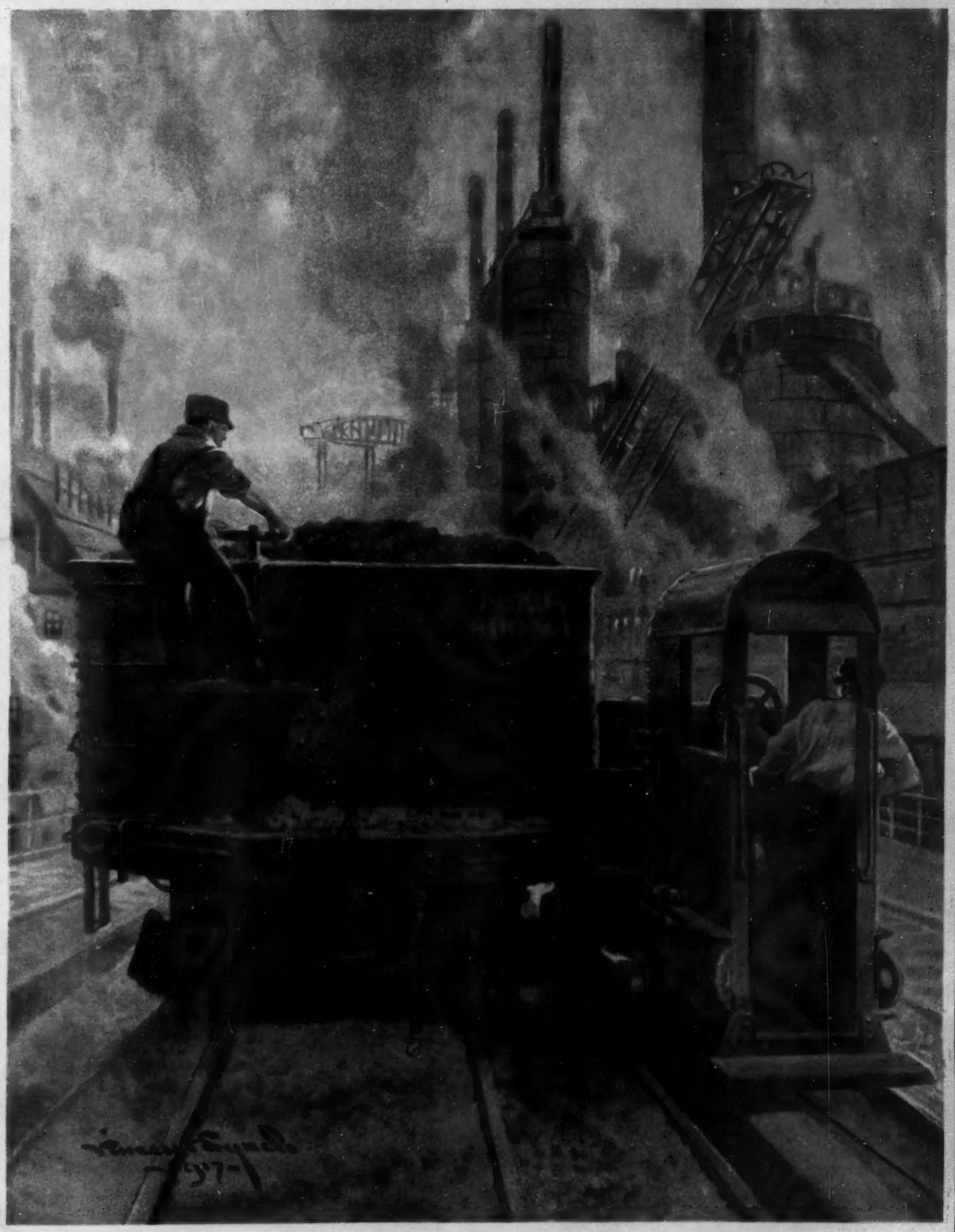

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August 18, 1917

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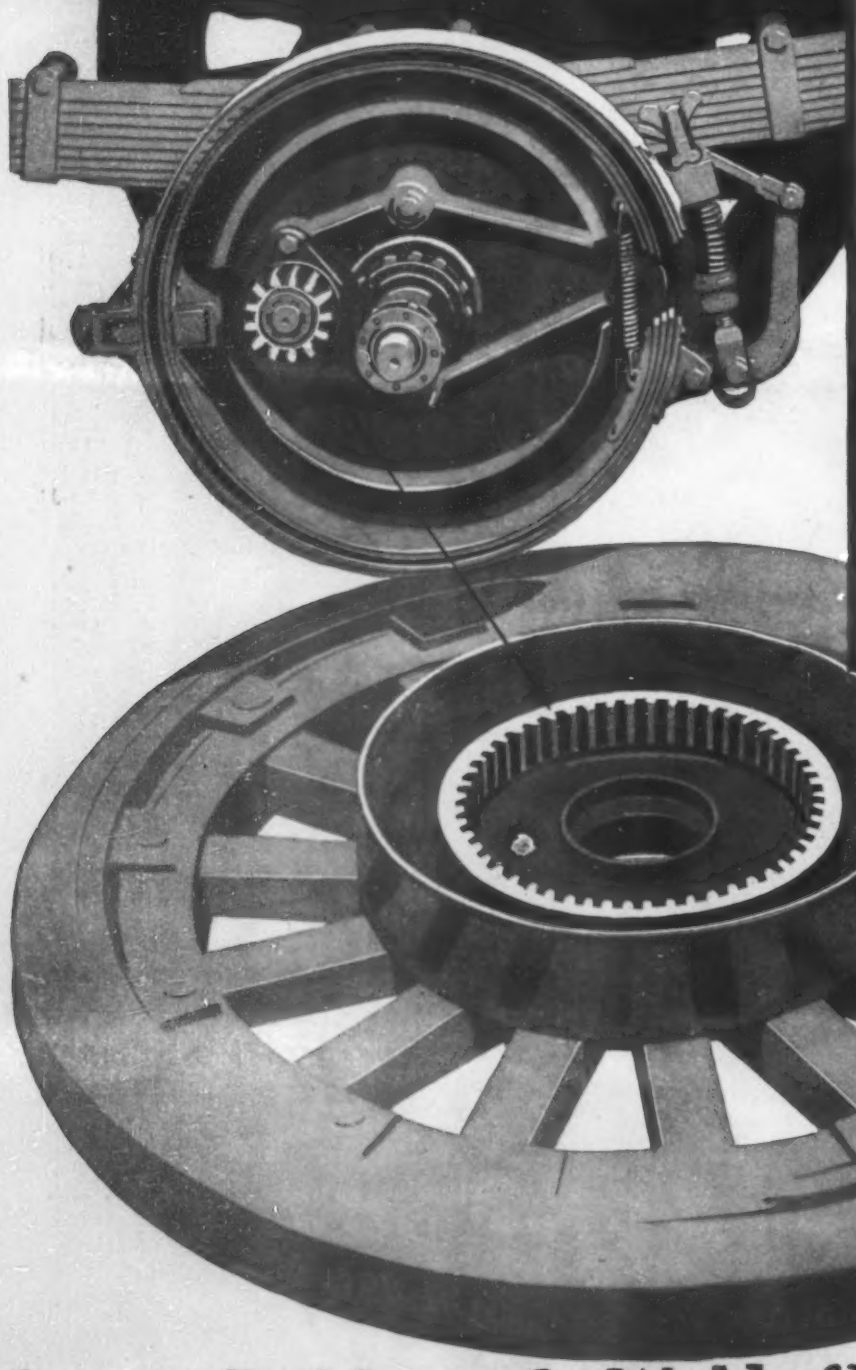

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